PUBLIC WORKS

Devoted to the interests of the engineers and technical officials of the cities, counties and states

AUGUST, 1937

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TIMEWASTERS

Coming Changes:

Somewhere in the rear pages of this issue we are running some of the many letters that come to us from folks who seem to enjoy this column. The four printed are but a very few of those we have on hand; others will appear from time to time. Also, in the September issue, we shall try to show our idea of a timewaster; and beginning in that issue, we shall also try to run the solutions on another page of the issue in which the problem is printed.

Foremanship Management:

Right in line with some of the articles planned for coming issues of PUBLIC WORKS on "how to do it" we offer this one from Link-Belt News: Two men and five boys were hired to dig a ditch and got half of it done in six days. In order to speed up the work, the foreman hired one more man and one more boy and the increased gang did two-thirds of the remaining work in three days. He then finds he has only one more day to finish up the job and that there are no more boys available. How many men must he hire?

An Indiana Product:

A boy has a piece of heavy cardboard that is 40 inches long and 24 inches wide. He wants to make a box that has the greatest possible capacity, the procedure being to cut a square out of each corner and bend up the sides and ends until they come together. One side of the square so cut out will equal the depth of the box. This was a little tough for the boy, so he called on his pappy for help in figuring the size of the square. Papa, in turn, calls on Timewasters, via H. A. Blunk for help. And Mr. Blunk suggests that the answer might just as well be to the nearest thousandth of an inch.

Comments:

John Bevan's suggestion in our July issue, which sounded so innocent, regarding the path around the cone, the path to rise 5 feet in each complete revolution, should have had an adverse effect on movie income if many of the folks stayed home to work on it, and an adverse effect on corporation income if they worked on it during office hours. Well to make it short and simple, we'll take Mr. Bevan's word for it that the answer is 10,062.27 ft. As to the clockwatcher problem, most agree that the time spent at lunch was about 55.38 minutes. The sock problem by Mr. Brumbaugh was a little over our head. Mr. Blunk says that he ought to get a match in drawing three socks. We check the bet to Mr. Brumbaugh. W. A. H.

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A. PRESCOTT FOLWELL, Editor — **W. A. HARDENBERGH,** Asso. Editor

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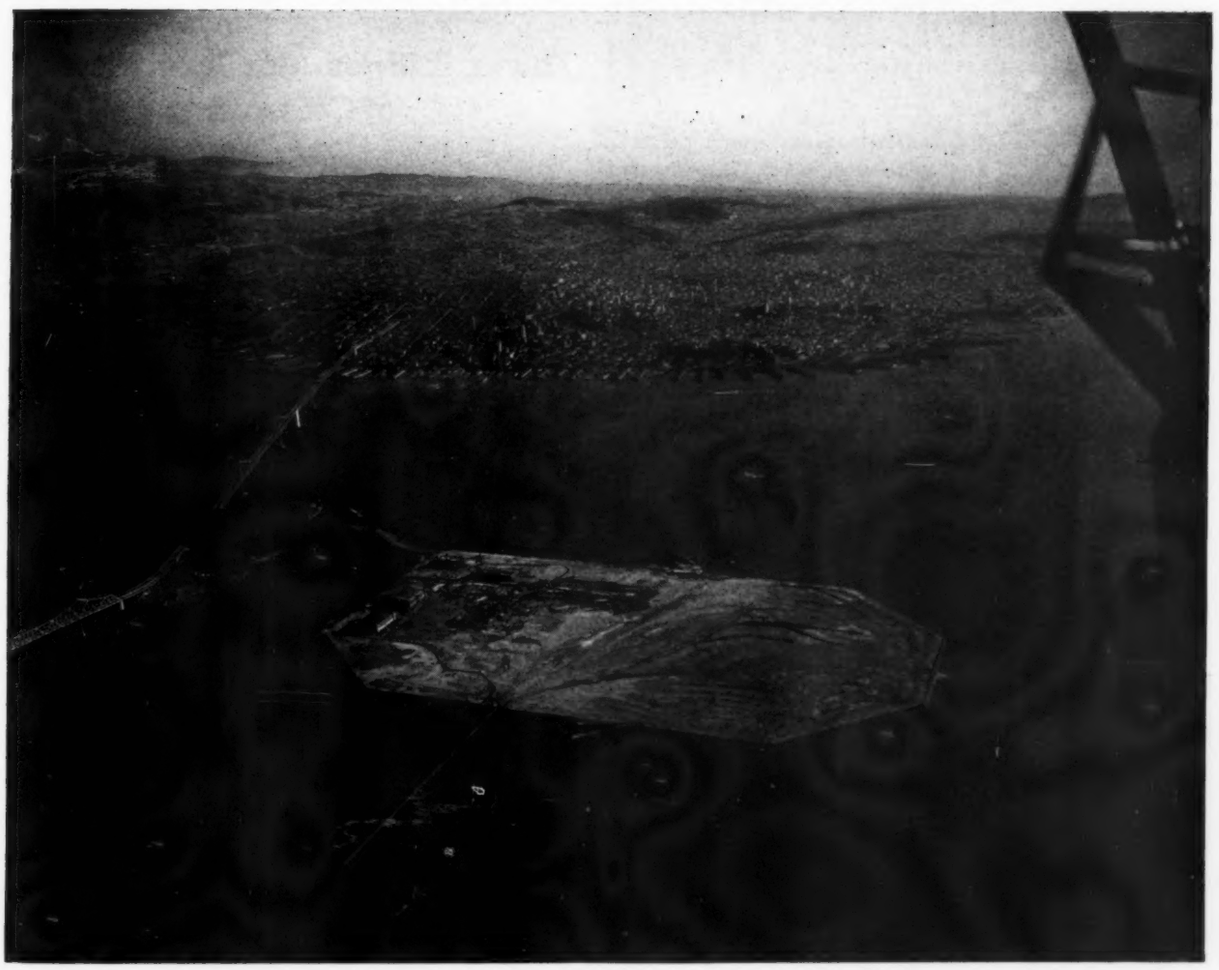
PUBLIC WORKS
City, County and State Engineering and Construction

AUGUST, 1937
Vol. 68, No. 8.

The San Francisco Bay Airport—Exposition Island



Treasure Island, in San Francisco Bay, site of 1939 Golden Gate International Exposition. San Francisco in background.

THE largest man-made island ever built, it is believed, has been created in San Francisco Bay to serve as a grand central municipal airport, after temporary use as the site of the 1939 Golden Gate International Exposition.

Where the island named "Treasure Island" stands today, the water of the bay two years ago averaged about 15 ft. deep at mean low water. The area, about 400 acres, 5,520 ft. long by 3,400 ft. wide, was surrounded by a sea wall 17,760 ft. long, containing 287,000 tons of quarried rock in units weighing up to 5 tons. The enclosed area was filled with 20,000,000 cu. yds. of sand obtained from the bottom of the bay by hopper and pipeline dredges, eleven of which operated for 18 months in making the fill.

This island is on Yerba Buena shoals, just north of Yerba Buena island (which is the central point of the new San Francisco-Oakland Bay bridge), and has been connected to it and the bridge by a highway, thus bringing it within ten minutes' ride of downtown San

Francisco or Oakland—as convenient an air terminal, serving the entire metropolitan and bay communities, as is enjoyed by any large city in the country. The site was selected for this purpose in 1931 from 14 possible ones by a commission of experts, and during the formative stages the exposition idea was joined with the airport plan.

The cost of the island, hangars, and other features of the airport project, estimated at $7,000,000 (of which the cost of the island itself is $3,803,000) is carried jointly by PWA, WPA and exposition financing. The two permanent hangars, each 287 by 335 ft. and 74 ft. high, will each cost $400,000 and the airport terminal building $800,000. All other buildings for the fair will be temporary, and after the fair will be removed to permit using the area for a landing field. Also three of the six highway lanes connecting "Treasure Island" with Yerba Buena island and the bridge will be built on a trestle and removed after the fair. Enclosed on three sides by the two islands and the causeway connecting them will be a basin for the use of hydroplanes.

Ferries will afford additional means of communication with the two sides of the bay, and ferry houses are being built on both sides of the island. One of these, on the Oakland side, is being equipped with a railway apron to handle building materials and consignments of exhibits, before conversion to passenger use.

Water Supply

Water for the fair will be brought from San Francisco by means of a pipe line supported by the bridge. Ten-inch standard steel pipe, with slip and spherical joints to accommodate the flexing of the bridge structure, will carry water, delivered to it by four booster pumps on the San Francisco shoreline, to a 3,000,000-gal. reservoir on Yerba Buena island elevated 260 ft. above tide water, to be lined with gunite, from which it will be delivered by gravity to all parts of the fair grounds through a distribution system of more than 16 miles of pipe, to which are connected 200 fire hydrants.

About 6 miles of 12″ to 6″ pipe will distribute the domestic water, reduced to 60 lb. pressure; and ten miles of 16″ to 6″ steel mains will be used for fire protection at 100 lb. Also connections are furnished by which San Francisco fire boats can pump salt water from the bay into the mains. The water will be used not only for fire protection and domestic purposes but also in connection with the $1,500,000 horticultural program. Some 4,000 trees, 70,000 shrubs and 700,000 flowering plants will require an estimated 300,000 gal. a day, and a 9-acre lagoon will evaporate approximately 45,000 gal. Altogether, the average demand is estimated at 1,800,000 g.p.d., and the maximum demand at 8,000,000 g.p.d. The cost of the water system is estimated at $600,000. All of the distribution system except the mains servicing the permanent airport buildings will be removed at the close of the fair.

Temporary fair structures are now going forward under a dozen contracts. These include 27 exhibit palaces in six blocks surrounding the 400-ft. central tower. These are of framed timber, bolted together for ease in dismantling and finished with plaster surfacing to accord with the exposition's new "Pacific" style of architecture.

Sewer Bridges Marsh on Series of Caissons

A sewer system built on a bridge of caissons has just been completed by the Works Progress Administration as part of Old Harbor Village, a Federal Housing Administration unit, in South Boston, Massachusetts.

Initial examinations of the land, adjacent to Dorchester Bay, showed it to be of such a marshy character that ordinary sewer excavation would not suffice. After considerable study engineers decided that the only feasible system was to build 540 concrete caissons at 12-foot intervals over a distance of a mile and a half.

Despite obstacles presented by the marshy ground the sewer system of the $7,000,000 FHA unit was completed May 30 by WPA work relief labor a month ahead of schedule. Laborers worked within three-foot steel shells in digging foundation holes for the concrete caissons. The steel shells protected diggers from cave-ins of the peat and muck through which caissons were sunk. When firm ground had been reached the bottoms of excavations were "belled out" for concrete. Steel shells were removed after concrete had been poured and set.

Depths of concrete caisson columns range from 10 to 30 feet. The concrete caissons support both storm and sanitary sewers for the needs of an expected population of 1,100 families at Old Harbor Village. The sewers are about five feet below the surface.

Following are statistics of material used in the construction of the Old Harbor Village sewer system by the Works Progress Administration:

Materials Used

Earth excavation	23,606	Cu. Yds.
Refill, earth	9,332	" "
*6″ to 15″ pipe	892	L. ft.
Steel, reinforcing	206	Tons
Brick Catch Basins	36	
Rock excavation	50	Cu. Yds.
Refill, gravel	421	" "
Concrete, Class "A"	4,685	" "
Caissons, concrete filled	540	
Manholes, brick	78	

*A considerable part of the sewer system is built of concrete.

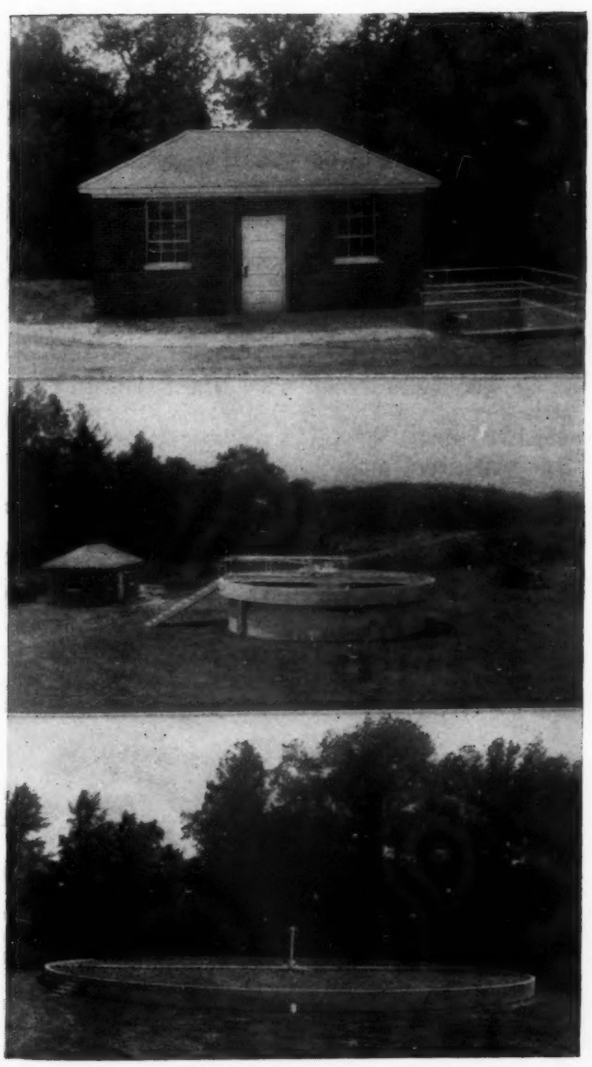
The picture at the left shows the very difficult conditions under which the Old Harbor Village Sewer, described above, was built.

Sewerage System and Treatment Plant as a Self-Liquidating Project

By J. W. GOODWIN
Consulting Engineer, Birmingham, Ala.

FOR many years the City of Leeds, Alabama, desired the convenience of a sewer system and modern sewage treatment plant but could find no way to finance the project. In March, 1933, the Alabama Legislature enacted a Revenue Bond law (Act 102 General Laws of Alabama) which gave municipalities the right to issue revenue bonds to construct and operate sewerage systems and treatment works; the bonds issued for this purpose not being a general obligation of the municipality nor counted against its debt limitation, but secured only by a first mortgage on the system, pledging the revenue derived from a sewer rental collected from the users of the sewers, less operating costs, for the payment of the principal of and interest on the bonds. The Act further provided that bonds could be issued for a period not exceeding 30 years but must fall due serially, the first bond maturing not later than 5 years after issuance, and no amount maturing in any one year to be more than 2½ times the smallest prior maturity.

Top—Final settling tank. Middle—Digestion tank. Bottom—Sludge beds.



Top—Pump house. Middle—Primary clarifier. Bottom—Filter bed.

In February, 1935, the city council employed the firm of J. W. Goodwin, consulting engineers, to make the surveys, estimates, and designs for a sewerage system and sewage treatment plant, and file an application with the Public Works Administration for a loan of $55,000 and a grant of $45,000 to provide funds to construct the project; the loan to be secured by 4% sewer revenue bonds. It was found, based on the present population of 3,000 people, that there were 500 potential customers consisting of business houses, residences, schools, etc., now in Leeds which could connect at once. Based on charging a monthly service charge of $1.00 per month per customer, it was estimated that the project would be self-liquidating, after allowing 10 years to connect all of the present customers, and would pay operating cost, interest, and retire the bonds in 30 years, with a surplus of approximately $40,000, not

allowing for any new customers due to increase in population.

The project was approved by the Public Works Administration in August 1936, and work was begun October 1, 1936, and completed on June 10, 1937.

The city now has a sewage system of approximately 46,000 feet of pipe lines, discharging into a complete sewage treatment plant which at present is considered by the State Health Department as the most modern plant in the state, carrying the treatment further than any other plant in the state. This was necessary because the point of discharge of the outfall sewer from the plant was into Little Cahaba river, which empties into Lake Purdy, which is the source of water supply of the City of Birmingham.

The cost of the project was $70,000 for the collection system and outfall sewers, and $30,000 for the treatment plant.

The treatment plant consists of the following units:

1. *Hand-cleaned bar screen;*
2. *Pumphouse,* housing two sewage pumps, one 200-gallon-per-minute and one 500-gallon-per-minute, both float control; one sludge pump, time clock control; and one chlorinator for chlorinating either the raw sewage in the pump pit or the filter effluent, or both;
3. *Primary clarifier,* mechanically cleaned;
4. *Filter,* with rotary distributor;
5. *Final settling tank;*
6. *Digestion tank;*
7. *Sludge drying beds.*

The plant was designed on the basis of 100 gallons per capita per day and a population of 4,000 persons, this being assumed to be the population of Leeds in 1950.

The primary clarifier was designed for a 2-hour detention period, the final settling tank for a 1½-hour detention period, and the digester for 3 cu. ft. per capita. The digestion tank will not be heated at this time.

The filter was designed for 2,500,000 gallons per acre per day and the sludge drying beds were designed on the basis of 1 sq. ft. per capita.

City water was piped to the plant and a working pressure of 50 lbs. is available at each unit of the plant for use in operation and cleaning up around the plant.

Given proper operation, it is believed that the plant will discharge an effluent which will reduce the bacteria over 99% and will give 90% reduction in bio-chemical oxygen demand. The system was officially dedicated on June 17, 1937, and put into operation.

Compacting Highway Fills with Crane and Ball

A portable crane and 2500-pound iron ball was used by the contractor on a California highway contract to break out the old existing pavement, and it was noticed that over old fills, considerable settlement took place during this operation.

It was therefore thought that thorough pounding might accomplish satisfactory consolidation without removal and recompaction over shallow fills.

The portable crane and ball operated over an area of 154 square feet per hour at a cost of $8.79, equal to 5.7 cents per square foot, and was able to break up the old pavement and drive it into the old fill and lower the grade of the entire area by one foot.

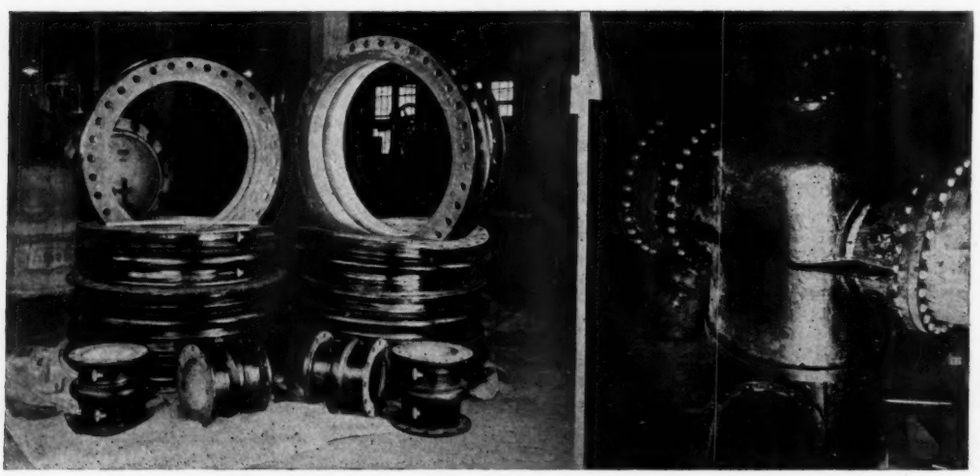
Relative compaction tests taken before and after tamping show increases as follows: Directly underlying the existing pavement, compactions increased from 89.1% to 92.9%, and at a depth of 5 feet, the increase was from 82.1% to 91.8%. The soil was a mixture of black adobe and brown clay, with a moisture content far above the optimum value, running 28% to 33%, and therefore accounts for the relatively low increase at the surface, the value of 92.9% being about the maximum compaction attainable under such high moisture content.

Centrifugal Blowers With Rubber Expansion Joints

Among the equipment recently installed at the new Easterly Sewage Disposal Plant in Cleveland, Ohio, is a battery of centrifugal blowers. These units are capable of moving 170,000 cu. ft. of air per minute. The largest of the blowers has a capacity of 40,000 cu. ft. per minute. The intake line on each blower has a suction pressure of 10″, water gauge, and the outlet has a discharge pressure of 7½ lbs. gauge.

Provision for expansion and contraction of these lines, due to frequent thermal changes, has been made by installing special rubber expansion joints which were designed and made by The B. F. Goodrich Company, Akron, Ohio. In addition to absorbing movement of the lines, use of these joints on the outlets prevents vibration from being transferred from blower to distribution line. Fig. 1 shows one of these rubber expansion joints connecting the blower outlet to the distribution chamber.

A group of these rubber joints is shown in Fig. 2. The large ones are used on the outlets and small ones on the intake lines. The rubber is specially compounded to provide for long aging to resist continual flexing, and a 2-ply cord fabric reinforcement is added. Those joints used on the intake lines have an added double wire reinforcement to enable them to withstand the collapsing pressure.



Rubber Expansion Joints on Cleveland Sewage Treatment Plant Air Lines.

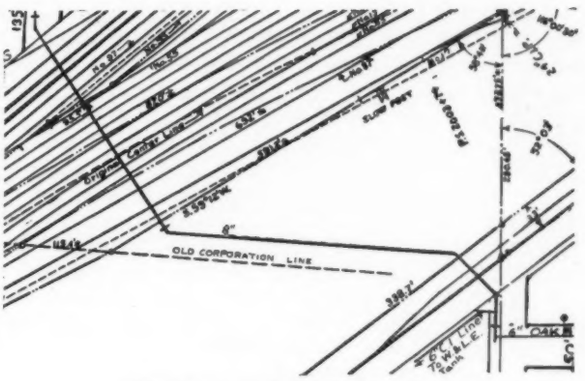
Laying Waterworks Main Across Railroad Yards

By A. D. WEBSTER,
Sup't., Waterworks, Orrville, Ohio

FOR some time Orrville, Ohio, officials had been looking towards the elimination of an outstanding defect in the layout of the distribution system of the municipal water works, caused by extensive railway yards separating the important sections of town into what are known as the west end and south side. Early in the F.E.R.A. program, work on this was started from plans previously prepared in our office, and approved by engineering departments of the two railroads affected. Under the supervision and leadership of our few key men, a creditable performance and a good grade of workmanship have been secured. The costs naturally reflect trenching by hand instead of by machine.

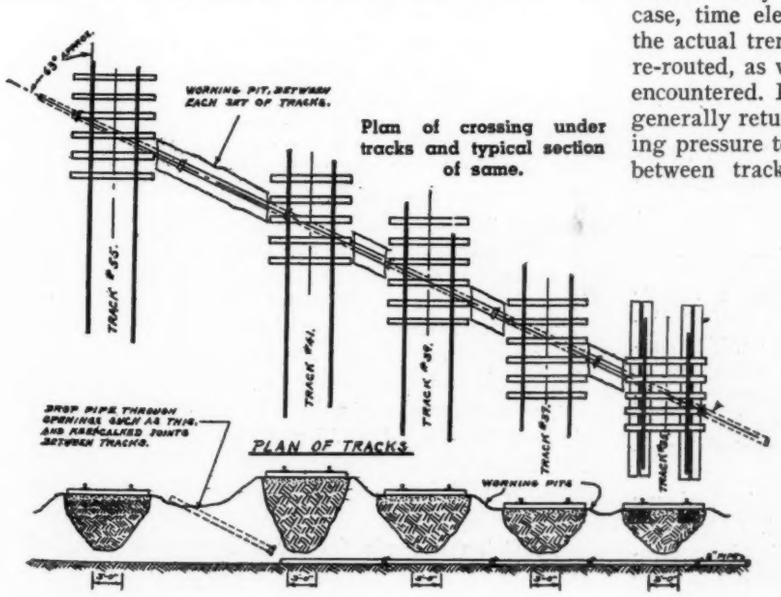
Little of interest attaches to the normal installation of lead-jointed 8" cast-iron pipe laid in the usual manner, of which most of the work consisted. But some unusual conditions were encountered in the laying of pipe across the railroad properties, including two tracks of the Wheeling & Lake Erie Railway, numerous yard tracks, and six high-speed tracks of the Pennsylvania Railroad system, comprising two of the Cleveland Division (Akron-Columbus) and four of the Pittsburgh-Chicago main line, via Ft. Wayne. Local railroad representatives and our office cooperated in selecting a route combining minimum length and lowest practicable number of track crossing, which number was 20. The railway officials gave valuable assistance and complete cooperation, even moving the pipe from utilities storage to the site by rail for part of this project, a rare exception to the general use of truck delivery alongside trenches nowadays.

A start on the actual railroad crossing was made from the south side Oak Street line, previously dead-ended near the Wheeling Railway, where a corrugated galvanized iron casing was specified. This was installed successfully in open-cut trench after old bridge timbers had been worked under the ties parallel to rails to bridge the excavation. Three 12-ft. lengths were laid and aligned and the backfill was rapidly placed and tamped. Throughout the entire work on railroad property an exceptional amount of attention was given to back-filling and prevention of cinder contamination. Through this casing a water pipe was jacked, using surplus 8" black iron flanged pipe. Transition to lead jointed fittings were made at the bends required at each end of this run of rigid pipe, so that no trouble from expansion is probable. The further precaution was taken of applying protective asphalt coatings on the pipe exterior, bolts and flanges, and good drainage was provided.



Pipe line crossing railroad yard.

The pipe laying proceeded next down a considerable declivity to grade under the Cleveland-Akron-Columbus line tracks at the south boundary of the main group of yard tracks. The corrugated iron casings method was similarly employed under two tracks here. In this case, time element considerations were negligible in the actual trench cutting, and train traffic was readily re-routed, as was possible for all the next yard tracks encountered. Backfilling was completed and the track generally returned to service that same evening. Working pressure tests against temporary plugs were made between tracks. Twelve-foot and eighteen-foot full lengths of cast iron pipe were juggled in order to get joints to occur in the working space between yard tracks. Top of pipe line was held five feet under base of rail.



Plan of crossing under tracks and typical section of same.

Laying the Pipe

In the approach to the other main line tracks at the north boundary of the yards, the water line had to be depressed to correspond to the lower level occupied by the Ft. Wayne main line. For completion of the new connections to the west-end stub line on Westwood ave., work across the tracks was minimized as much as

possible. Very frequent train movements (80 per 12 daylight hours), as well as general safety requirements led to the selection of a rotary boring method often employed by the natural gas companies for their lines in this region; otherwise some tunnelling method would have been necessary to maintain stable road-bed and avoid "slow orders" against the heavy freights and fleet of passenger flyers (headed by the "Broadway Limited") on this route. Final decision in favor of the power-boring method was influenced by test-holes showing coarse gravel and some quite large stones in the drift formation.

Briefly, the boring method employed a casing envelope of 14″ O.D. size, 37-lb. steel pipe, having attached to the head end a slightly over-size toothed and hardened cutting shoe. This cutting head and successive lengths, about 20′ long each, of the 14″ casing were revolved by a machine having provision for manually jacking the casing forward through a thrust bearing. A 1½″-pipe was inserted through the driving machine and casing to keep a water jet at the cutting face, washing back the excavated material. The rotating machine was heavily blocked and braced in correct alignment on the bottom of an access trench 25 ft. back from the first railroad track. A vertical chain connection transmitted drive power from a gasoline motor unit on the trench bank. Two intermediate set-ups with flanged filler sections were required to work in the full lengths of casing from the nominal 9-ft. propelling range of the driving head, the successive lengths of 14″ casing being connected by oxy-acetylene weld for mechanical drive strength.

In the 65-ft. length, a 14″ deviation off horizontal alignment and a 5″ drop out of level resulted. This was easily compensated for in the next adjacent joints of the 8″ cast iron pipe inserted through the 14″ casing. Full 18-ft. lengths were used, resting on a creosoted, hardwood cradle slid into the casing along with the conducting pipe to prevent any load bearing on the bells. For further precaution against vibration, the first joints outside the enclosing casing were made with Dresser couplings. The annular space around the 8″ pipe at the end of the 14″ casing was closed with masonry, after wrapping asphalted felt expansion material on the water pipe. No extra drainage provisions appeared to be necessary.

For the remainder of work after the crossings under tracks, some short runs of trench excavation, pipelaying and backfilling completed connections to a new loop tying in two dead-end lines in the "west-end." The entire project included 2,123 lineal ft. of trenching, 2 hydrants, and 6 valves; material-truck-tool cost was $3,444.60; our labor and supervision, $521.79; and $2,359 for relief labor. Of the grand total, $985 was for the complicated 4-track crossing described above, covering 62 ft. of casing, 96 ft. of 8″ pipe, fittings, machine rental, tool and construction equipment charges.

Recovery for Engineering Services

Action was brought by engineers against a village for engineering services in connection with the installation of an improved water and sewer system. The contract referred to detailed cost estimates, attending of hearings and the assistance of the village attorney in the prosecution of the condemnation, special assessment and special tax cases. It also contemplated payment in cash or special assessment or special tax vouchers. The Illinois Appellate Court held, Charles DeLeuw & Co. v. Village of Midlothian, 7 N. E. (2d.) 506, that the contract was not void for lack of prior appropriation, especially in view of the fact that the village had insufficient debt incurring power to pay for the contemplated improvements of taxation.

The engineers were held not precluded from recovering on the contract on the ground that the services were not performed in good faith because the village had no water supply, that special assessment ordinances were void for lack of provisions for water supply, and lack of outlet, and because special assessment proceedings were dismissed because the village had no outlet for the sewer system, where, under the statutes, the village had the right to compel delivery of water to its mains and to contract for a supply of water and had the duty to show the availability of the outlet for the sewer system.

Stabilization Specifications of Pennsylvania Highway Department

Stabilization specifications issued by the Pennsylvania Department of Highways, under date of March, 1937, provide for an increase in the proportion of coarse aggregate in the mixture and also two-course construction. Pennsylvania has a great variety of aggregates and soils and these specifications are designed to utilize local materials to the greatest possible extent with a view to keeping the stabilized type of base and wearing course as low-cost as possible.

Five designs are provided for varying local materials. These are outlined as follows:

Design Number 1—
Binder Soil or Soil + Screenings; Binder Soil or Soil + Sand; or Run of Bank Stabilized Soil.

Design Number 2—
Design No. 1 + Penna. No. 2B Coarse Aggregate or other aggregate of approved gradation, as may be indicated.

Design Number 3—
Bottom Course "A" (Coarse Material) = Design No. 1 plus any of the following materials: Coarse Reddog, Coarse Shale, Coarse Gravel, Coarse Stone, Coarse Slag, or Other Coarse Material.
Bottom Course "B" (Graded Material) = Soil plus any of the following materials: Graded Reddog, Graded Shale, Graded Cinders, Graded Gravel, Graded Stone, Graded Slag, or Other Graded Material.
Top Course = Design No. 2.

Design Number 4—
Run of Bank Gravel + Binder Soil.

Design Number 5—
Run of Bank Stabilized Gravel.

The gradation of 2B Coarse Aggregate, as mentioned in Design No. 2, is as follows:

Passing 1½ inch sieve	100%
Passing 1¼ inch sieve	85-100%
Passing ⅝ inch sieve	10- 40%
Passing ⅜ inch sieve	0- 8%

Aggregate up to 3-inch size is permitted in Bottom Courses "A" and "B" in Design No. 3. Reddog is an incinerated mine waste, available in large quantities in the coal regions of the state. While it has been used in some stabilized wearing courses, its resistance to weathering and traffic wear is not as great as that of other common aggregates, so that its use in these specifications is restricted to base courses.

The maximum liquid limit for the soil fines in these designs is specified as 35 and the maximum plasticity index as 12. It is probable, however, that a majority of projects will be designed with a P. I. much lower than 12.

Provision is made for the use of chemical admixtures, as specified for individual projects.

Jacking a Corrugated Culvert Under a State Highway

Methods, Equipment and Cost of Replacing Failed Culvert Under Deep Fill by Jacking Method.

By WARREN VAN DYKE
Secretary Pennsylvania Highway Department

COLLAPSE of an old culvert under a highway near Pittsburgh prompted the Pennsylvania Department of Highways to resort to an ingenious and unusual method of replacement—driving the pipe through the ground with heavy jacks.

The original pipe had been installed during new construction on State Route 19. It merely was laid in a shallow trench and covered with fill, over which ran the new highway. When the pipe failed, the cave-in served as a dam and blocked drainage.

To tear up the highway and dig down to the same level to put in a new pipe would have meant traffic delays and a heavy outlay of funds. Instead, we jacked a 36-inch corrugated iron pipe 50 feet beneath the surface and through the 200-foot fill. It was the first such operation undertaken by the department. The cost was $5,000 but it would have been greater had we employed any other method of replacement.

Aside from successful completion of the job, the department gained valuable experience in the method required in handling work of this character in the future. Several interesting arrangements were required.

The setup consisted essentially of a jacking abutment, a guide for the pipe, two 50-ton jacks, and the necessary blocking and fittings to transmit the pressure of the jacks to the pipe.

After the material had been assembled and the location of the proposed pipe determined, it was decided to jack the pipe from the lower end. It was found by measurement that the pipe would have a grade of 2.9 per cent to reach the desired point at the up-stream face of the fill.

The most important phase was the jacking abutment. Because of the marshy nature of the soil, the bulkhead did not have sufficient resistance to the thrust of the jacks and it was necessary to hold it down with cables attached to "dead men," and with sandbags piled on a platform.

A track was laid for the guidance of the pipe. This consisted of two 12″x12″ timbers, laid 18 inches between their near faces. These were set at the proposed grade and armored on the inside upper edges with 3″x3″x5/16″ angles.

The department purchased two 50-ton jacks with 24″ lift for the project. The jacks, weighing 310 pounds each, were well suited to this type of pipe jacking as the unusual lift avoided frequent changing of the blocking. They also will be useful for bridge jobs and similar work in the future.

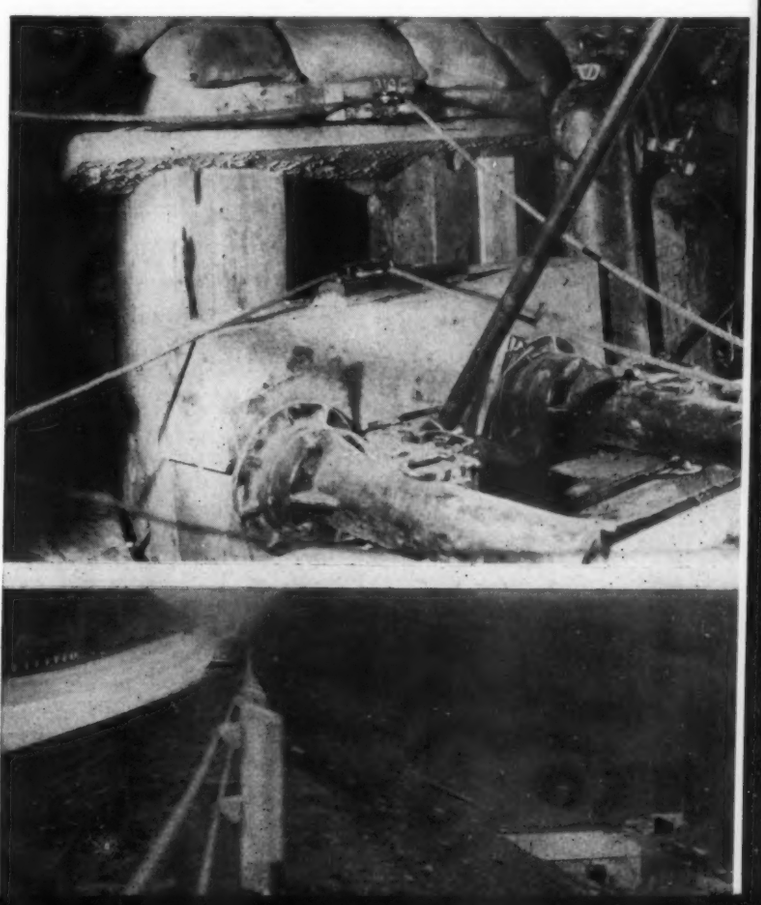
A shed was built over the jacking layout to protect the men from weather conditions, since it was considered necessary to keep the pipe moving day and night. This brought up the question of lighting and a small gasoline driven lighting plant was used. An extension line was carried into the pipe to light the work of the diggers. This was better than oil lamps, both for efficiency and ventilation.

Ventilation early became a matter of concern and a bad odor apparently due to decaying vegetation became noticeable after a short time. A department air compressor was installed, together with a rented hand digging machine with spade blades, and the air from this equipment did the double service of power and ventilation.

The Armco pipe used was 1/8 in. thick and in 10-foot sections, except the first two were 12 feet long. On top and bottom were riveted slip plates with the corrugations running longitudinally. These were designed to lower friction on the pipe caused by the transverse corrugations.

Four coal miners were used in digging the first hundred feet, two men on each 12-hour shift. Each man worked in the pipe a half hour, then rested the same

The upper picture shows the jacking arrangement necessary to force the pipe through the fill. The lower view shows the fill and in the lower corner the building from which the work was carried on.



length of time. Afterwards, two more diggers were put on, one on each shift.

It should be emphasized that these diggers are key men and the pipe advances only as fast as they remove the earth from before it. They also must have sufficient skill and care to steer the pipe properly.

The method of directing the pipe is of interest. Two boards ½"x3"x36" were bolted together in the center so they could be folded up or opened to right angles at the digger's convenience. Each board had slits cut in it about six inches long. When set up and levelled with a carpenter's hand level, one arm was horizontal and one vertical. The digger, by holding his lamp behind each slit in succession, made it visible from outside where line and grade sights were placed clear of the work.

It was important to hold to line and grade as closely as possible and this was done by digging more out on the side to which the pipe needed directing, leaving the other side tight and helping with the bar. This, however, left a tight spot which increased the friction. The line and grade had to be watched frequently to prevent these spots from being too large. Shallow trenches were excavated across the bottom of the tunnel at frequent intervals to prevent any loose material which might be carried along with the pipe from accumulating to an extent which would interfere with jacking.

Few large stones were encountered. The fill was largely a homogenous mixture of clay and small stones or shale.

When not using the air digger, the men used spades with cut-down handles about 18 inches long. They also used short-handled miner's picks and dug two feet ahead of the pipe with about three inches clearance all around. The pipe was then jacked and digging resumed.

Labor at the jacks was divided into three shifts of eight hours each, six men to each shift. From the time jacking was started until it was completed, 18 days and 14 hours of practically continuous work elapsed. About two days in all were lost resetting the jacking abutment. The average progress was better than a 10-foot section a day.

The chief difficulty was holding the jacking abutment in place and it was necessary to anchor it down. At times the 50-ton jacks were working practically to capacity with extension pipes over the jack handles and three men to each jack. The thrust was, of course, severe and the posts of the jacking bent tended to lift. It was recommended that in future work of this heavy nature, a concrete abutment be built or a crib filled with lean concrete be used. It should be kept low so as not to interfere with the flow of water after the pipe is in place. It could be designed as part of the headwall and apron of the finished structure.

The average cost of the job was $24.51 per foot. The cost items were as follows:

Cost of getting material on job and erecting bulkhead	$ 267.80
Cost of tearing down bulkhead and digging inlet and outlet ditch	223.05
Actual supervision and cost of digging and jacking pipe	2494.31
TOTAL SUPERVISION AND LABOR	$2985.16
Garage payroll, including equipment and operators	233.20
Equipment rental (trucks, compressor, etc.)	554.97
Miscellaneous costs (lumber, rope, wagon, lighting fixtures, pulleys, bolts, spreaders, angle irons, etc.)	282.58
Total cost of 36" pipe 204 feet long	$ 994.52

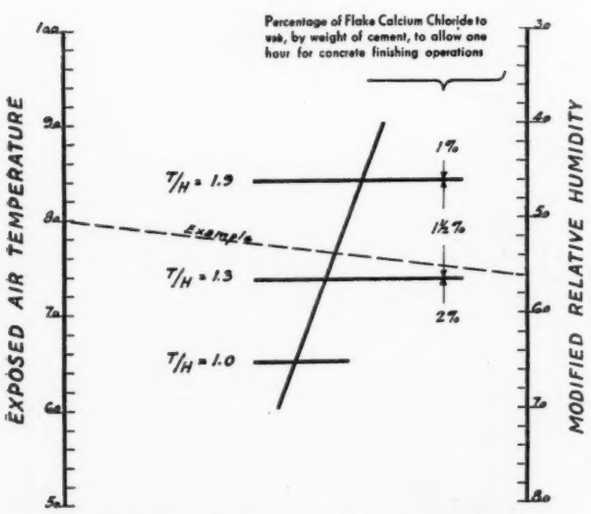


Chart for Figuring Calcium Chloride for Concrete Curing.

Lessons From the Flood for Water Works Men

Water works men learned several lessons from the floods of last spring, chief among them the following: Keep all equipment in first class operating condition; have standby power available for pumps and mechanical equipment; have plenty of chemicals, alum, lime, carbon, chlorine, ammonia, etc., on hand, storage of a month's supply not too much. Keep clear well and elevated tank full all the time; know where shut-off valves on distribution system are so they can be shut off if necessary; arrange for temporary safe water supplies such as well, cisterns, in case of failure of public water supply (these should be chlorinated before use). When public supply is placed back in operation, be sure all contaminated water that may have entered the supply is flushed out and the system is thoroughly chlorinated, at least a residual of 50 p.p.m. and bacterial samples of several sets showing no B. coli after chlorine residual is back to normal operation. Warn all people to boil water if system is in any way affected by flood water and supply might become contaminated.—*Illinois Department of Public Health.*

Determining Amount of Calcium Chloride for Concrete Highways

A chart for determining the amount of calcium chloride to use integrally in concrete highway construction has been developed by the Calcium Chloride Association. In using this chart, the determination of the exposed air temperature and the modified relative humidity are necessary. A wet and dry bulb hygrometer is used for this, which shows these directly on a central revolving scale. The chart used is shown herewith. The method of use is as follows: If the dry bulb temperature is 80° and the relative humidity, as determined, is 56, then connect these values (see example, dotted line) with a straight-edge, and note where it crosses the diagonal line for per cent of calcium chloride to use. In the example, 1½% by weight of cement, is required, or about 1½ pounds for each sack.

Flood Control in a Southern Kansas Drainage District

By O. C. CARLSON
Supervising Engineer, Cowskin Drainage District, Wichita

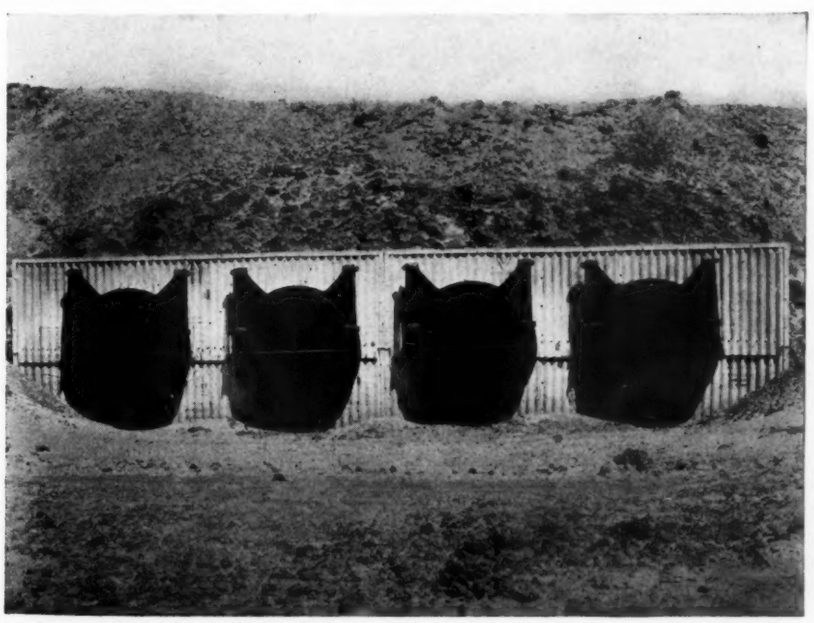
FLOOD control is not alone a problem of large rivers. Cowskin Creek, located a few miles south of Wichita, Kansas, has long been a source of damage to farm land and crops. The first organized effort against its flood waters was started on December 27, 1916, when the Cowskin Drainage District, comprising some 200 square miles, was organized.

Due to the present interest in water control and the available federal funds, the District has been able to accomplish a great deal of improvement work recently. During the period from October 1, 1936, to July 1, 1937, the expenditures have totaled $97,500. This includes both federal funds and the sponsor's contribution. The local unemployment situation has been considerably alleviated by the employment of an average of 125 men throughout this whole period.

The maximum volume of water to be provided for is 5,200 second feet. In order to take care of this discharge, the creek has been widened to give a channel 48 feet wide across the bottom with sides of 2 to 1 slope. A levee 6 feet high was built to protect the surrounding land. These levees, 300 feet apart, will take care of water 11 feet above the low water mark of the creek.

There are numerous places where drainage must be carried under the levee into the creek, but protection must be given against high water backing through the levee. Multiple lines of asbestos bonded Armco pipe with a paved invert were installed under the levees as is shown in the photograph; and Calco automatic drainage gates were used for protection against backwater. This type of flexible pipe was considered desirable because foundation conditions are very unstable.

Above, excavating the Channel. Below, Calco gates in position to prevent backwater flow



The quantities involved in the construction of this project will give some idea as to its magnitude; 120,500 cubic yards of earth excavation for the channel, 143,417 cubic yards of earth excavation for the levees and 27,500 cubic yards for other work. Some 200 acres of heavy and 116 acres of light clearing were necessary before the work of excavation could be started.

Modern equipment was used for the excavation, including two 7-yard hydraulic scrapers powered with 75 horse-power tractors, and a 1¼-yard drag-line, all of which were in constant use. All slopes of the levees were finished, however, by the use of hand labor.

The resident engineer was K. W. Willey. The project was designed by the Kansas Engineering Company of Topeka, Kansas. The present members of the Drainage Board are L. F. Wagner, chairman; W. F. Duval, treasurer; Wayne Bearly, secretary.

Public and Private Cooperation in the Development of Sewage Treatment

NEARLY eleven years ago the Connecticut State Water Commission brought to the attention of the city administration of New Britain the necessity of improving its sewage treatment plant. This, a sand filtration plant, was hopelessly overloaded, resulting in complaints and suits for damages.

The engineers of the commission made detailed studies of the volume and character of the sewage, including the industrial wastes discharged into it. Several consulting engineers were employed by the city and four separate plans were submitted. The sewage during warm and dry summer weather is rather strong and contains a substantial volume of industrial wastes, many of them from metallurgical industries, and recent developments in chemical treatment seemed to offer advantages, while the wastes were inimical to biological agents.

The final outcome is described as follows by the commission in its latest report:

"In April 1935 the city, having received a very attractive price on the construction of a plant from a company which had developed and patented a modified chemical treatment process,* requested the approval of the State for its construction. As no plant embodying the principles which it was to employ had ever been built, it was proposed that a model or pilot plant be constructed at New Britain and operated for a sufficient period of time to determine whether or not it could meet the standards of purification fixed by the State.

"The construction company accepted this proposal and proceeded to build at New Britain, entirely at its own expense, a plant capable of treating 100,000 gallons of sewage per day. This pilot plant was put into operation about June 30, 1935, and operated continuously until August 1, 1936. The State Water Commission maintained a force of samplers at the plant for 24 hours per day for two months, and its consulting chemist with three assistants was engaged constantly on this work for this period. In addition to this, our consulting chemist analyzed samples, made up of composites collected over each period of 24 hours in proportion to the flow of sewage, for an additional month. During the entire 13 months period, determinations of suspended solids and biological oxygen demand of both the raw sewage and the treated effluent were made daily by chemists employed by the company. The records of all this experimental work are in the files of the State Water Commission.

"In October, 1935, the Commission felt, in view of the results obtained to date, that it was justified in advising the city that the proposed method of treating the sewage would produce a degree of purification satisfactory to the State. The following spring the city let a contract for the construction of the plant and it will be completed and ready to be placed in operation shortly after the first of the year.†

"As stated earlier, this plant is unique in that none has ever before been constructed which combines the various features employed. There were, therefore, no data showing just what results might be expected. Briefly, the essential features of the modified chemical process consist of the following steps:

(a) Sedimentation of the raw liquor;
(b) Addition of salts of iron, alkalies, chlorine or other chemicals;
(c) Addition to the raw and settled sewage of varying quantities of sludge obtained from the sediment which collects in the final settling tank;
(d) Flocculation (or slow agitation) by compressed air, for varying periods of time, of the sewage after addition of chemicals and the returned sludge;
(e) Final sedimentation.

"Chemical precipitation of sewage is a very ancient art practiced in one form or another since before the Christian era. Sedimentation, flocculation and mixing of "return sludge" with raw sewage are operations that have been used in sewage treatment for many years. The modified chemical process under consideration has assembled these several steps and a patent has been granted on the ground that a substantial improvement in the art of sewage treatment has been made.

"Compared with plain sedimentation, and chemical precipitation with sedimentation, experience indicates substantially better results will be possible with this modified method as measured by the biological oxygen demand removal. The following figures give comparative results which may be expected in this respect:

PERCENTAGE REMOVAL OF ORGANIC MATTER
(BIOLOGICAL OXYGEN DEMAND)

Plain Sedimentation	Chemical Precipitation with Sedimentation	Modified Chemical Process
25 to 40	30 to 60	40 to 90

"It is hardly necessary to point out that the adequacy of any method of sewage treatment depends on efficient operation of the plant but, where chemical precipitation is employed, the degree of purification is almost negligible unless skilled and constant supervision is provided. This implies not only competent personnel to operate the plant but a constant supply of the chemicals required.

"It has been estimated by consulting engineers employed by the city that an activated sludge plant would cost $650,000 to build, and sprinkling filters approximately $1,000,000, while the contract price for the chemical precipitation plant was $400,000. On the other hand, the cost of operation of a chemical plant is higher than for some plants depending upon biological processes."

* The Guggenheim Process.
† The plant went into operation this spring.

The Editor's Page

The Problem of Small Plant Engineering

Of five requests for information and advice that came in yesterday's mail from our readers, and are this morning lying on the editor's desk awaiting reply, three have to do with small plants problems. This is about the average, and is one reason why considerable attention is paid to this matter in our editorial columns. Of the three small plant letters, two referred to sewerage and one to water supply.

A large city embarking upon a sewerage treatment project is financially able to employ the highest type of consulting engineer, and to carry on investigations, even over a long period of time, to determine proper procedure. The small community is either not able to do this, or thinks it is not.

More information on the subject appears to be needed to serve the very many small communities in our country. The need refers not only to sewerage and water, but also to highway and street surfacing, and to equipment for doing the work—in fact to all phases of small-town and rural engineering. The editors of this magazine are glad to receive from our readers questions, discussions and articles on the subject.

Financing Sewage Treatment

Many municipalities hesitate to go forward with vitally needed sewerage construction because the operation of sewerage systems and of treatment plants represents a drain on the community budget. On the other hand, expenditures for water works improvements are often voted more readily because the water department is a money-making organization, as a rule.

But, after all, the money comes from the same place—from the pockets of the citizens who go to make up that community. The income of the water department comes from the water users; of course, and properly, the charge is usually based on service rendered, as by the thousand gallons of water used. This fact does not in any way change the situation. Net income from a water department represents only the surplus, above expenses, of the sums collected from the citizens of the community. A service is rendered; a charge is made. It is essentially unimportant whether the charge is made in one way or another.

A sewer system and a sewage treatment plant renders also an extremely valuable service to the citizens of a community. As a rule, the service rendered saves money in that the cost of sewage collection and treatment is less than for individual cesspools or even septic tanks. There is only one way to pay for this service—just as in the case of the water works system—and that is by getting the money from the benefited citizens. In most cases this represents almost the entire population, directly and indirectly.

There is little excuse for postponing needed sewage treatment and sewer construction. Recent methods of treatment have reduced the cost of construction and of operation. A realistic viewpoint of the source of the money and the benefits to be derived from its expenditure are important.

As a matter of fact, money can usually be saved if both water and sewerage systems are built at the same time. After water has been provided, sewers are inevitable, and the need for them is realized—and often physically so—more and more as time passes.

Among the advantages of constructing the sewer system and treatment plant at the same time that the water system is built are: The cost is usually less than if each is built separately; financing arrangements can be made at one time; engineering fees, incidentals and extras are apt to be considerably less; and the streets are torn up but once.

As before stated, the money for both services comes from the citizens of the community, but the outgo is richly repaid in convenience, protection to health, and added property values.

Low Cost Road Materials

During the past 6 or 8 years, there has been tremendous progress in the details of construction of low-cost roads. As a result, today's road of this type, even though it costs but a few hundred dollars a mile, must provide a riding smoothness almost undreamed of less than a decade ago; it must also have economy of maintenance —or to use a modern term, it must "be able to take it."

Changing motor vehicle trends, with increased speed of ordinary travel, and with greater volumes of traffic, have imposed higher demands upon the construction methods and also upon the materials used in construction. The specifications for materials for many types of these low-cost surfaces are notoriously liberal or "open." So long as these materials were furnished primarily by a few large companies which had a material stake in the prosperity of this field, and maintained a high quality of product, these liberal specifications did no harm. But with the great increase in the usage of these materials, many smaller producers or dealers have appeared, not all of whom have been able to maintain their products within those limits that experience has shown to be desirable. As a consequence, a tightening of the specifications may be necessary. In the meantime, price alone should not be the determining factor in selecting such materials; a small saving in first cost may be poor economy in the end.

Road Striping for Safety

There is and should be a lot of talk about this business of killing some 35,000 people a year in highway accidents. Many of the remedies proposed are expensive and will take a long time to carry out. They should be carried out, though, just as soon as possible. In the meantime, let us make our present roads just as safe as we can. Proper marking and striping of the highways is an important safety factor. About this time of the year, unless markings have been renewed, some of the lines are getting pretty faint. Remarking to have the lines clearly visible may prevent many accidents.

Seasonable Facts and Suggestions

Suggestions for Summer Operation of Tractors

By G. D. Groce

In the summer season, with most tractors doing their heaviest work under extreme dust conditions, too much emphasis cannot be placed on cleanliness in handling fuel and lubricants and on the proper servicing of air cleaner, breathers, oil filters, and fuel filters.

A gasoline engine, such as used in the Model AG (Cleveland) tractor, requires approximately 100 cubic feet of air per minute (correspondingly more on larger models) when operating at governed speed. All of this air must be taken in through the air cleaner—hence, the importance of keeping the air cleaner *clean.*

Proper attention to the air cleaner is even more important on Diesel engines than on gasoline engines because of the extreme closeness of all measurements and the damage that excess wear can cause. The only difference between dirt and emery dust is the difference between the speed at which the two can do their damage. Furthermore, Diesel engines take in the same volume of air on each intake stroke regardless of the engine speed or the work which it is doing.

In addition to cleaning the air cleaner, the transmission, clutch and engine breathers also should be washed and re-oiled at frequent intervals to prevent dust being drawn into these compartments.

Transmission oil filters should be inspected and cleaned at regular intervals.

And while you're taking care of these safeguards, give some thought to making the load of these safeguards as light as possible. The proper handling of fuels is a case in point. Containers should be tightly covered and kept thoroughly clean. Before removing filler caps, clean away all dust and see that no dirt or dust blows through the fillers.

Too much care cannot be given to this point, especially on Diesel tractors. The only way to be absolutely sure of clean fuel entering the injection system is by preventing any dirt from being mixed with the fuel before it is placed in the tractor.

The best time to clean filters is after the tractor has been idle for several hours. Then, a great amount of dirt will have settled to the bottom of the filters where it can be most readily removed.—*Cletrac News.*

Applying Red-Lead Paint in Hot Weather

SOMETIMES it is stated that to paint steel surfaces when they have become very hot from exposure to the sun is not good practice. In considering this question it should be borne in mind that red-lead paints and other paints can be successfully baked at temperatures ranging up to 200° F. Marking paints applied on hot-rolled sheets at the mill frequently outlast coats of paint subsequently applied.

Black bulb thermometers placed in the sun and shielded from the wind during the hottest weather are not likely to show a temperature of over 140° F. Steel structures probably do not reach a temperature over 115° F. At this temperature there is neither excessive oxidation of the linseed oil nor excessive hardening of the film.

Of course, heat facilitates the drying or oxidation of linseed oil and moisture retards it. These two influences, therefore, are opposed to each other in action, and on hot humid days in the summer the drying may not be all that is desired because of the larger amount of moisture present in the atmosphere.

Another factor of importance is that heat causes linseed oil to expand and lose viscosity with the result that the paint becomes very thin. When paint in this condition is applied to a hot surface it spreads so far that the resulting film is very thin. In addition the hot surface may cause trouble from running. This naturally would affect the durability of the job.

Aside from these two factors, however, which can be largely overcome by care in application and by allowing sufficient drying time, there is no reason that red-lead applied to a surface with a temperature of 115° F. should not give good service. The superintendent of the old Louisville bridge of the Pennsylvania Railroad preferred to have all paint applied in the summer time and on days when the thermometer showed 90° F. or more. As this bridge required painting only four times in 44 years, it certainly shows that the high temperatures had no ill effect on the paint's durability.—*Dutch Boy Quarterly.*

Attempted Reduction of Sealed Bid

A contracting firm which had bid on the completion of public works after the default of the original contractor sent a telegram to the proper officer before the date for opening sealed bids, reducing its bid by $1,500. It developed that they were the lowest bidders, without regard to the telegram. In an action against the surety for the excess cost of completing the work under the original contract, the surety contended that, upon receipt of the telegram, the superintendent of works should have rejected all bids.

The New York Supreme Court, Special Term, Albany County, People v. Caldwell-Garvan & Bertinio, Inc., 294 N. Y. S. 122, held that although the superintendent of public works had the authority to reject all bids, he was not compelled to do so, and would not have been justified in incurring the additional expense of advertising for new bids. He could not in any event accept any bid except a sealed bid, and the telegram could not constitute a sealed bid or any part thereof.

Bids For Patented Pavements

A city charter provision required paving contracts to be made upon specifications and competitive bids. It was held, Vilbig v. City of Dallas, Supreme Court of Texas, 96 S. W. (2d.) 229, that these requirements were met by specifications incorporated in the city's offer for bids on patented pavements, although it permitted bids on three patented articles, on one article controlled by one concern, but permitted bids on one article which all could use and bid on. The specifications offered different types of surfacing materials. The bidders on the patented materials were in full competition with each other and with the bidders on the non-patented material; and the latter were in full competition with the former.

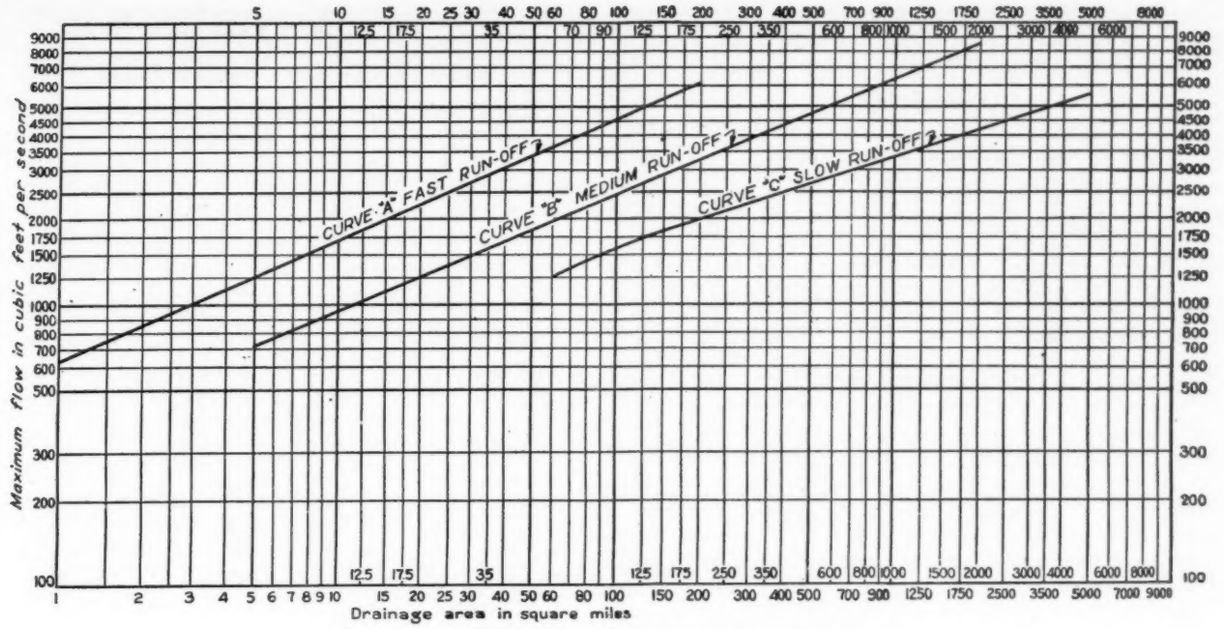


Fig. 7—Spillway capacities for small dams in North Dakota

Instructions for the Design and Construction of Small Dams

Prepared by L. C. Tschudy and John G. Sutton, Engineers, U. S. Department of Agriculture, under the direction of Lewis A. Jones, Chief, Division of Drainage

THESE instructions cover the design and construction of dams suitable for Civilian Conservation Corps work in North Dakota, and data relating to runoff, spillway capacity, etc., should be used cautiously for work in other states. References are to dams not exceeding the following average heights above stream beds: earth dams, 20 ft.; rubble masonry dams, 10 ft.; timber crib dams, 8 ft. Dams described are intended primarily to store water for flood control and water conservation purposes and to raise the water table in bottom lands. No provisions have been made for draining the reservoirs.

This is the second and final installment. The first appeared in the July issue.

Determination of Spillway Capacity

For convenience in determining spillway capacity necessary for different projects, the probable run-off for various conditions has been estimated and recommended capacities are shown in Figure 7. These curves are determined for various watershed areas by the Rational method of computing run-off and from stream flow records. Earth dams must not be overtopped and an ample factor of safety must be allowed in order to insure safe structures. The following instructions govern the determination of spillway capacity of dams to be constructed by the Civilian Conservation Corps camps in North Dakota.

Curve A shall be used to determine spillway capacities of earth dams in hilly and rolling country. The flow from this type of watershed is more rapid than from flat areas and is classified as fast run-off.

Curve B shall be used for flatter slopes where slower flows will occur and represents medium run-off; to be used only for earth and masonry dams where little damage will result from failure.

Curve C shall be used to determine the spillway capacity of rubble masonry and timber crib overflow dams on flat streams which will have comparatively small run-off per square mile. The rate of run-off from such areas has not been great and if the dam is overtopped slightly more than anticipated no great amount of damage is likely to occur. Curve C shall not be used to determine the spillway capacities of earth dams.

The extent of the probable damage, should the dam be overtopped, is one of the most important considerations in determining spillway capacity. When the amount of water stored is so small that, should a failure occur at the maximum flood flow, the liberation of impounded water would not cause much damage, a smaller spillway is permissible.

The flow over an excavated spillway where the entrance is sloped and there is free flow at the outlet, can be determined by the weir formula:

$$Q=CLH^{3/2}$$

where Q=discharge in cubic feet per second
C=constant
L=width of spillway in feet and
H=depth of water over crest of spillway

For a paved spillway having free flow at the outlet, use C=2.5, and for excavated spillway with loose rock riprap and free flow, use C=2.25. Where the back-

water may cause congested flow at the outlet of an excavated spillway, use C=2.0. These figures are considered conservative.

Freeboard

The freeboard of the dam should usually be at least 3 feet above the maximum stage estimated to occur when the spillway is discharging at the flood rate selected for the design. If the capacity of the spillway cannot be estimated accurately or is indeterminate, a larger freeboard should be allowed, depending on the damage that would result if the dam failed. If a long natural spillway is available it is permissible to reduce the freeboard to 2 feet.

Construction of Spillway

The spillway designs considered most suitable for earth dams are shown in Figures 5 and 6. Where rock is plentiful, rubble masonry at least 18 inches thick should be used for constructing walls and floor. Plain and reinforced concrete 8 to 12 inches thick can be used with the same general plans where rock suitable for rubble masonry is not available and concrete construction is cheaper.

An excavated spillway is desirable. The entrance should be flared to improve the hydraulics of the channel, as shown in Figure 5. The bottom of the channel should be graded accurately and the sides sloped carefully. Rock for the floor should be hand laid and the voids filled with cement grout. The channel below the spillway should be paved or riprap placed where necessary to prevent dangerous erosion. The outlet of the spillway should be carefully aligned so that the flow will be deflected in the direction of the original stream bed in order to minimize the effect of eddies which might cause erosion of the downstream face of the dam.

A depression in the bank can sometimes be used to form a natural spillway. Where a spillway is not paved or riprapped, the influence of vegetation on the discharge should be carefully considered.

Design of Masonry Overflow Dams

Although it is desirable to construct a masonry overflow dam on solid rock, this type of foundation is not always available. In designing a masonry dam for construction on an earth or poor rock foundation, the uplift pressure and buoyancy from tail water enter into the design and must be considered.

The types of masonry overflow dams recommended for use in North Dakota are shown in Figures 8 and 9 and other details of construction are shown in Figures 10 and 11. The principal difference in the two designs is in the method of draining the downstream apron. The apron of the section shown in Figure 8 is drained at the downstream toe and must be heavy enough to resist uplift pressure. The apron thickness T for various heights of dams is shown in Figure 8. This type of dam (Figure 8) should be used for earth foundations where topography, soil and stream flow are such that it is not likely the soil beneath the downstream apron can be drained during the winter months.

The section shown in Figure 9 should be used for locations where it is probable that the stream bed will drain during the winter months. Drains laid as shown in Figures 9 to 11 should be provided beneath the downstream apron to dry out the foundation during the winter and thus prevent the apron heaving from frost action. The water from the tile lines drains into the riprap below the downstream apron. A trench should be extended downstream for a sufficient distance to drain the riprap during the winter months.

The design of the spillway, wing wall, and sheet piling is practically the same for both sections shown in Figures 8 and 9. The lip of the spillway has been sloped in front and designed with a large section to

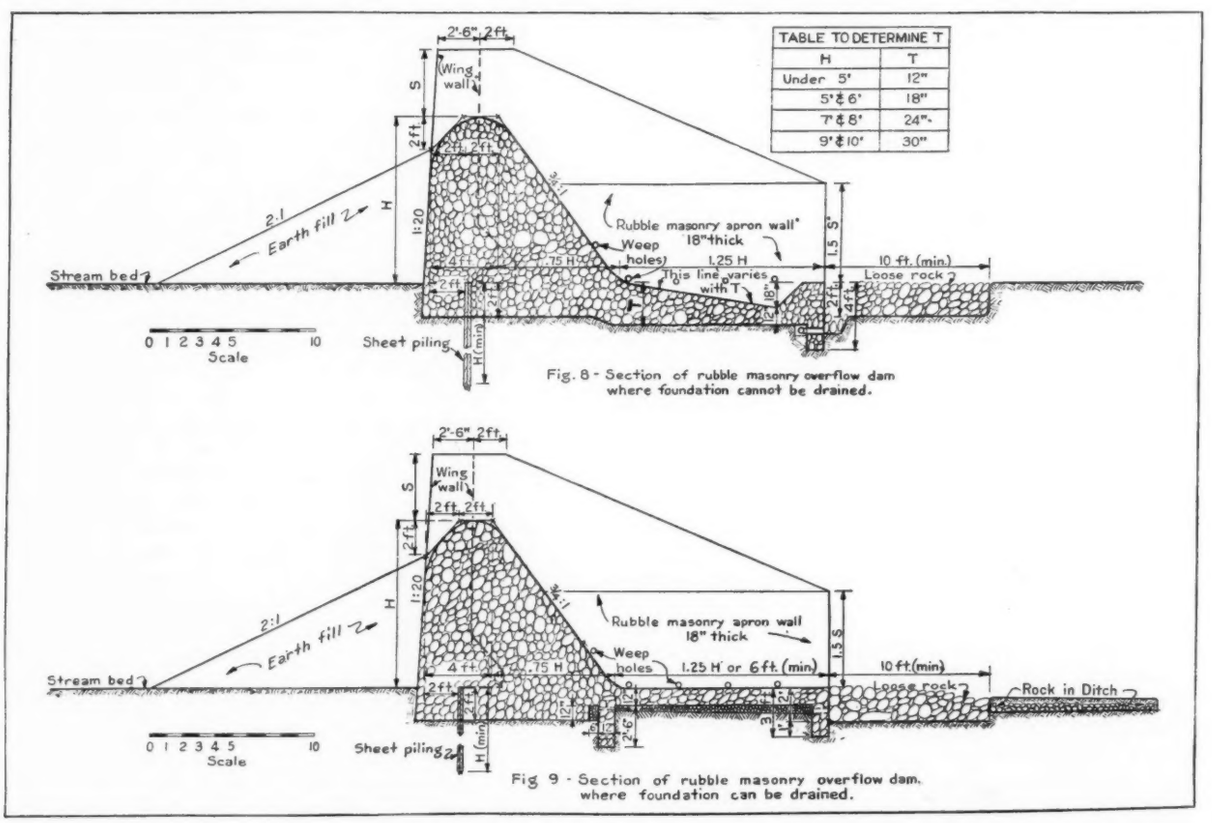


Fig. 8—Section of rubble masonry overflow dam where foundation can not be drained. Fig. 9—Section of such dam where foundation can be drained

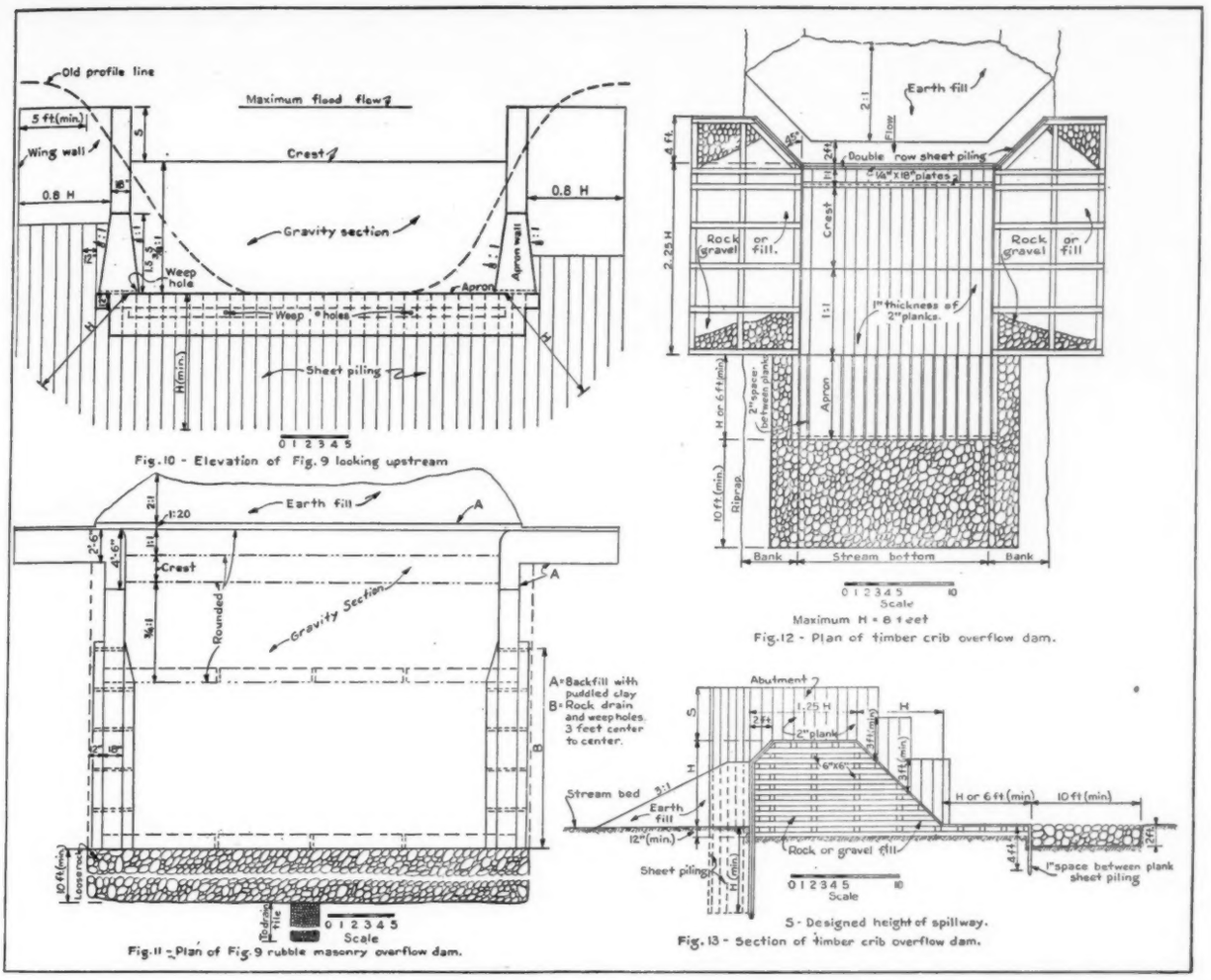


Fig. 10 - Elevation of Fig. 9 looking upstream.

Fig. 11 - Plan of Fig. 9 rubble masonry overflow dam.

Fig. 12 - Plan of timber crib overflow dam.

Fig. 13 - Section of timber crib overflow dam.

Fig. 10—Elevation of Fig. 9 looking upstream. Fig. 11—Plan of Fig. 9 rubble masonry overflow dam. Fig. 12—Plan of timber crib overflow dam. Fig. 13—Section of Fig. 12

resist ice pressure. The spillway should be slightly curved at the crest and at the base to conform approximately with the natural curve of the water. It is not considered practicable, due to construction difficulties, to round the spillway to conform exactly to the shape of the nappe.

The arrangement of the wing walls and apron walls depends on the topography of the stream bed and length of the weir. These walls should have ample dimensions and should be carefully constructed so that water cannot seep around the ends of the dam. (Such connections with stream banks are frequently inadequate and washing occurs around the ends.) Wing walls should be so designed that the length of the path of percolation along any line beneath or around the wing walls is not less than the path beneath the dam.

The apron walls should have a minimum thickness of 18 inches, which will ordinarily be adequate in North Dakota. The wing walls should have a minimum thickness of 30 inches and footings, as shown in Figures 8 and 9. The height of the apron wall above the downstream apron should be at least 1¼ times the height of the wing wall above the spillway lip. The apron wing wall should be backfilled with porous material and drained, as shown in Figures 8 to 11. The downstream end of the backfill should be riprapped with large rocks.

Expansion joints are not considered necessary and need not be used in the rubble masonry dams covered by these instructions.

The necessary capacity of the spillway of masonry dams can be determined from Figure 7. The wing walls and apron walls should be high enough to confine the maximum flow within the banks of the stream. A freeboard of at least 18 inches should be allowed between the elevation of the top of the wing walls and the maximum estimated reservoir stage.

The damage to the structure if the stream should overflow its banks or exceed the estimated flood stage, should be considered. Protection of the dam against such contingencies by riprap is frequently desirable.

Preparation of Foundation and Construction of Dam

Excavation should be carried to a depth of at least 2 feet below the natural stream bed. A good foundation soil is required to support a 10-foot rubble masonry dam without appreciable settlement. A solid clay or a sandy or gravelly clay soil usually makes a satisfactory foundation to resist the pressures beneath a masonry dam of this height.

Drains should be carefully constructed, as shown in the plans. A trench about 9 inches square should be excavated to grade and filled with about 3 or 4 inches of gravel graded from ½ to 2 inches in size, sewer pipe 3 inches in diameter laid with loose joints carefully placed to grade on the top of the layer of gravel in the center of the trench, and the trench filled with gravel.

If possible, wood sheet piling should be driven to a depth at least equal to the height of the dam. A foundation having porous strata should be handled in the same manner as described for earth dams, by using core trenches filled with impervious material. If the sand and gravel strata are too deep, the site should be

abandoned. Where it is impracticable to drive sheet piling, a rubble masonry core wall about 18 inches thick should be constructed to a minimum depth of 4 feet for smaller dams, to 6 feet for a 10-foot dam.

The mortar should consist of a 1:4 mixture using Portland cement and a good grade of sand. For pointing, flush joints are considered most desirable. Where large stones are used, cement can be saved by inserting spalls and small rocks into the large spaces. All rock should have clean surfaces. Cleaning should be done with wire brushes. Care should be taken to completely embed all rock in mortar. The curves shown in the plans should be obtained by placing rubble masonry along the curved planes shown; although the rounding could be done by plastering, a thin layer of mortar would probably crack and such construction is not approved.

Timber Crib Dams

Timber crib dams should be used where the drainage area is large, where an overflow dam is necessary, and where it is difficult to obtain rock economically for a rubble masonry structure. Crib dams are desirable where it is difficult to drain off the foundation for proper rubble masonry construction. They may be built up to a maximum height of 8 feet. The necessary spillway capacity of timber crib dams can be determined from Figure 7.

The type of dam which should be used is shown in Figures 12 and 13. The abutments must be keyed into the banks so there is no chance of washing around ends. The sheet piling must be driven to a depth at least H below the profile. Two rows of sheet piling should be driven. The proper method of pointing the piling is shown in Figure 4. Planks 2 inches thick may be used if they can be driven; otherwise 3-inch planks should be used. The two rows should be staggered, thus forming a better seal against possible seepage. The piling should be securely fastened to the crib and the joints protected by plates as shown. Lag screws are very efficient in fastening the piling and decking to the cribs.

The piling at the downstream end of the apron need only be of one thickness but this should reach a minimum depth of 2½ feet to insure the dam against undermining. A space of 1 inch should be allowed between planks in the downstream piling so that any water accumulating in the crib can drain off when the backwater lowers.

Cribs, abutments, and apron must be filled with gravel, or with rock small enough to fill the spaces between the timbers.

The banks along the apron should be protected by riprap, the location and amount depending on local conditions. In all cases riprap should be laid to a 2-foot depth and a minimum length of 10 feet downstream from the apron. (See Figure 13).

The crib and piling should be lined up with a transit or chalk line so that the finished structure will have no open spaces between the sheet piling and the crib. This also produces a much neater job. The cribbing should be bolted together with ¾-inch round bolts.

The upstream deck should be sloped and the abutments should be placed at an angle of 45 degrees in order to increase entrance velocities for all heights of dams. The decking consists of 2-inch plain planks. The stringers are 6″ x 6″ placed 4′ on centers, or closer if necessary to stiffen certain parts of the structure.

The foundation should be excavated to a minimum depth of 12 inches. If unstable soils are encountered the excavation should be continued to a greater depth until a better foundation is secured. The engineer must exercise careful judgment in preparing the foundation.

Sanitary Requirements for Maryland Summer Resorts

Sanitary requirements for Maryland resorts are summarized by Dr. R. H. Riley, Director of the State Department of Health as follows:

Water Supply—Wells or Springs: Must not be located within 200 feet of privies or cesspools. Construction must be such as to prevent entrance of surface drainage. The drinking water must conform in quality to United States Treasury Department standards. The use of a common drinking cup is prohibited. Drinking fountains must be of a sanitary type approved by the Department.

Sewerage: Privies or other toilet facilities must be of an approved type, and must be maintained in a sanitary condition. Adequate facilities must be provided for washing the hands. The use of common towels is prohibited. Sewage and other waste must be disposed of in such a manner as not to create a nuisance or be a menace to health.

Premises: Buildings and grounds must be kept in a neat and sanitary condition. Care must be taken to protect against flies and mosquitoes. Breeding places of mosquitoes should be drained, filled or oiled periodically. Unprotected receptacles containing water may not stand for more than 24 hours. Garbage must be kept in metal cans with fly-tight metal lids and must be disposed of in an approved manner, preferably by burning or burying. Receptacles for the disposal of other waste such as paper, etc., must be maintained at convenient locations and the contents disposed of promptly by incineration or other approved methods.

Operating Permit: An operating permit for the current year must be on display at all times during the operation of the resort.

Protection of Food from Contamination: Premises where food is handled must be satisfactorily lighted and ventilated. Rooms in which food is prepared, and if practicable, those in which it is served, must be screened, or other means must be provided to prevent access of flies to food. Scrupulous cleanliness must be followed in washing utensils in which foods are cooked or served. Stored food must be maintained at a temperature below 50° F. at all times. Refrigerators must be properly cleaned each day. If the refrigerator is cooled by means of melting ice the drainage pipe must not be directly connected to a sewer. Milk and ice cream must be from an approved source and handled in an approved manner.

Bathing Facilities: Bathing water must be protected from all controllable sources of pollution. Dressing rooms must be washed daily, rinsed with an approved disinfecting solution and maintained in a sanitary condition. Bathing suits and towels must be cleansed in boiling water or an approved disinfecting solution after each use.

Legal Liability for Supplying Contaminated Water

While it is well established that water works can be held liable for damages for illnesses or deaths resulting in consequence of the suppying of contaminated water, such fact is still not generally appreciated by the operators of these utilities. A town's water supply may be of the highest excellence; yet if a situation exists whereby water from a polluted auxiliary source can be introduced into the mains, such hazard serves to impair in very large degree its supposed safety.

This department* has for years been active in endeavoring to bring about the abandonment of contaminated emergency sources for fire protection—the latter at one time a very common situation in this state and one local officials formerly were quite generally inclined to contend was indispensable. Such an arrangement, technically known as a "cross connection," is in the same category with that whereby a factory, for the sake of reduced insurance rates, maintains a secondary supply involving a fire pump with intake in some polluted stream. Nowadays, this factory situation is reasonably well taken care of in New Hampshire. However, we have but little more than commenced a campaign against a somewhat different, though equally hazardous state of affairs as involved by inadequately protected "interconnections" of industrial, hotel and institutional fixtures.

*New Hampshire State Board of Health.

In this connection, the following recent decision of the Vermont Supreme Court, as reported in the December 18 issue of "Public Health Reports," should be of interest. The lesson to be drawn from this case is that towns should insure their fire protection needs by the method of providing adequate fire pumping equipment rather than through dependence upon resort to a polluted source. Regardless of controlling valves, such an intake inevitably involves a potential menace.

"The defendant city at one time maintained a valve connection between the city water supply and a nearby river in order to assure an adequate supply of water in the event of an unusual fire. Somehow this valve was left open, thereby permitting the river water to flow into the mains which carried the water for domestic use. One, Joseph Boguski, contracted a case of typhoid fever which proved fatal. The plaintiff, his administrator, brought this action against the defendant city, alleging that the deceased contracted typhoid by drinking from the city's water supply. In addition to proving that the river water

was carried into the domestic water supply, evidence was introduced to show that the river water was polluted with colon bacilli; that typhoid bacilli are to be expected where colon bacilli are found; that milk, fruit, or shellfish, could not have caused the infection in the deceased; and that at least seven of the other cases of typhoid in the city could have been caused by drinking the polluted water of the city system. On the basis of this evidence the judgment in the lower court was rendered for the plaintiff, and on appeal this judgment was affirmed by the supreme court.

"The court found that the circumstantial evidence presented was sufficient to send the case to the jury, although it had not been show by direct evidence that the river water was polluted with typhoid bacilli. The court in the course of its opinion said:

"'* * * The question here in issue becomes a close one, only when we have to say whether enough appears in the record to charge the Winooski River with the responsibility for the pollution. It seems clear to us that the jury was well justified in its inference that the river was the responsible agency. Not only was the inference a logical one, but it seems difficult to see how any other could have been drawn from the facts disclosed.'"
—*New Hampshire Health News.*

South Carolina Contracts a Cement-Stabilized Base

SOUTH CAROLINA is building what is believed to be the first cement-stabilized base ever built by contract for a highway. Ordinarily base courses in that state are made of sand-clay or, where materials suitable for this are not available within economical hauling distance, of sand-asphalt. The State Highway Department has been experimenting for three or four years with soil-cement mixtures, and now feels that enough has been learned to enable them to prepare specifications and have such work done by contract. Accordingly a 10½-mile contract on State Highway 63, where materials for a sand-clay base are not available, has been let to C. G. Fuller at 49½ cents per squard yard.

Before letting the contract, the Department took soil samples along the road for laboratory testing, and worked up Proctor curves for optimum moisture and the density which they could expect; then ran a series of freezing and thawing durability cycles on cores having different cement content to determine the best and most economical amount of cement to use. The soil being used was checked from time to time during construction and the cement ratio changed as necessary. The moisture content specified was 6%; the amount of cement per square yard 6" thick averaged 0.1 barrel for the entire contract, but fell as low as .085 barrel in sandy sections.

The work consisted of gathering the material from the grade, mixing it with cement, spreading the mixture, compacting it and shaping it to the specified cross-section. A motor-patrol grader and a tractor-drawn blade grader are used to blade and scarify the soil until it is thoroughly pulverized, turning it back and forth to dry it out if the moisture content is too high. (One of the drawbacks to this type is the impossibility of operating in rainy weather.) In case of rain of short duration, the contractor covers the soil with tarpaulins, of which he has enough to cover 1,000 ft. or more of road. The soil so prepared is brought into a windrow in the center of the subgrade.

The contractor uses a Barber-Greene traveling mixer for mixing cement and soil. This scoops the soil from the windrow and elevates it to a hopper, which delivers it at a predetermined rate to a continuous pugmill. Cement is placed in another hopper, from which measured quantities are delivered to the pugmill. The two hoppers are provided with measuring gates so connected that, after they have been set, the ratio of cement and soil can vary only within very narrow limits. Water is added if the moisture content is less than that specified. The machine has a capacity of two cubic yards per minute, or 180 ft. of road an hour. It delivers the mixture in a windrow behind the machine and hand-shovelers spread it over the road to a depth of 8", to be compacted to 6". It is at once thoroughly compacted with a sheeps-foot roller, then given a preliminary shaping by a motor patrol, rolled with loaded trucks, and then given its final surface with the motor patrol. No shaping can be done the following day, as the mix is well set by then.

State Highway Departments Surface 28,913 Miles in 1936

State highway departments placed 28,913 miles of new highway surfacing in 1936, according to reports of State highway departments to the Bureau of Public Roads of the United States Department of Agriculture. The new surfaces consisted of 4,706 miles of high-type surfaces such as bituminous macadam, bituminous concrete, portland cement concrete, and brick and 24,207 miles of lower types of surfacing.

Subdivided according to class of road, there were 23,885 miles of rural primary State roads, 614 miles of urban extensions of State systems, 4,414 miles of secondary road under State control in the 14 States having administration of local roads.

For every mile of surfacing placed on an earth road 2 miles of new surfacing was placed on old surfaced roads. A large part of the resurfacing consisted of replacement of worn surfaces with higher types.

The designated rural primary State systems now include 340,160 miles. The year's work brought the surfaced portion to 289,103 miles or 85 percent, comprising 113,695 miles of high-type surfaces and 175,408 miles of low types. Those States having the largest mileage of high-type surfaced roads in the primary system are as follows:

New York	10,384
Illinois	10,126
Ohio	6,970
Pennsylvania	6,851
Texas	6,365

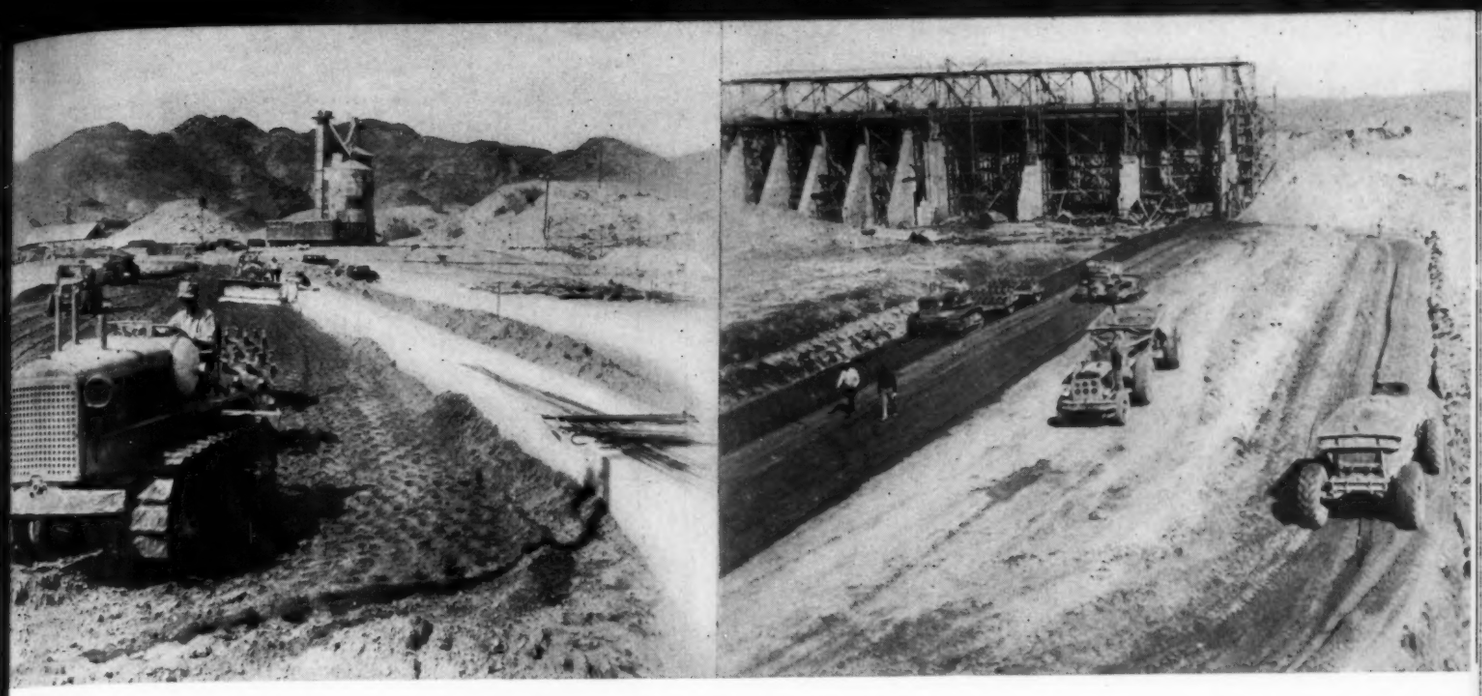
At the end of 1936 the existing surfaces on rural primary State roads were as follows:

	Miles
Brick and other block types	2,898
Portland cement concrete	81,283
Bituminous concrete and sheet asphalt	15,100
Bituminous macadam	14.232
Low-cost bituminous mix	33,805
Waterbound macadam	20,281
Gravel and similar surfaces	103,958
Sand-clay, topsoil, etc.	17,364
Timber bridge floors	182
Total	289,103

Bituminous treatments have been applied to 17,743 miles of waterbound macadam, 39,177 miles of gravel and 8,918 miles of sand-clay and topsoil.

Stream Pollution Damage

In a land owner's action for alleged pollution of a stream by a municipal sewage disposal plant, the Tennessee Court of Appeals held, Town of Dickson v. Stephens, 96 S. W. (2d.) 201, that the evidence was sufficient to show depreciation in rental value of plaintiff's farm by pollution of the stream constituting "special damages" to plaintiff's property not also suffered by the public at large. Evidence as to the extent of this damage was held for the jury.



General Views of Construction Work on Dam and Desilting Plant for All-American Canal Near Yuma.

Cutting the Overhead in Dirt Moving

By Use of Butane and by Welding Repairs

By JOS. C. COYLE

FROM the beginning of construction on the Imperial diversion dam and desilting plant at the head of the All-American Canal, near Yuma, Arizona, the extreme summer temperatures prevailing and the clouds of abrasive dust have made the maintenance of all moving equipment a major problem for all contractors concerned. The George W. Condon Construction Company, sub-contractor on all excavations and fills at the dam and desilting plant, in meeting it employed several variations from the usual maintenance methods, which have substantially cut operating costs and increased the efficiency of the equipment.

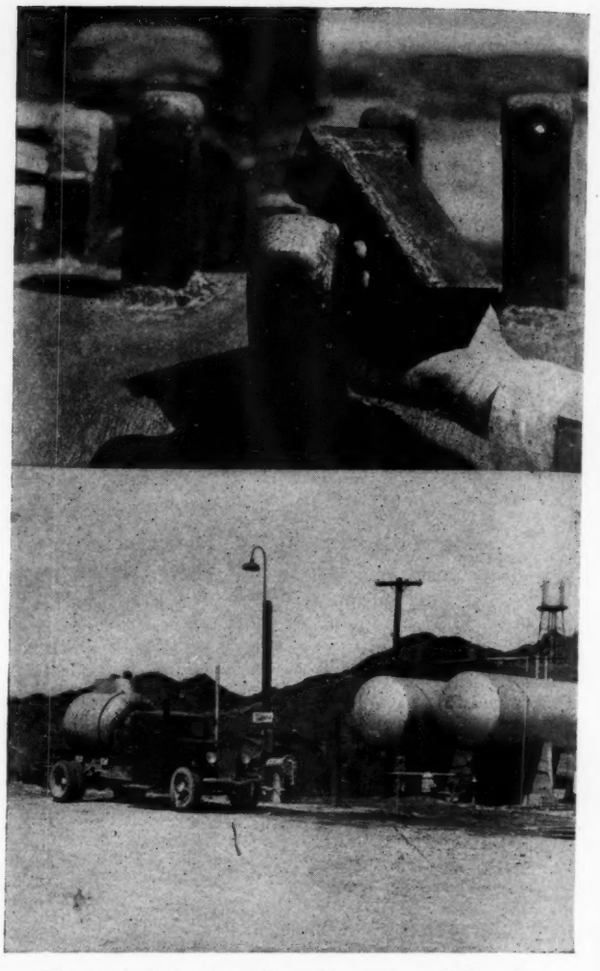
Condon equipment includes 13 Euclid dump-bottom semi-Trac-Truks; 8 end-dump Trac-Truks; six 7-yard and one 1½-yard International dump trucks; three 900-gallon water tanks and one 1000-gallon butane transport truck on International chasses; 5 Allis-Chalmers bulldozer equipped tractors; one 2½-yard dragline, and two 2½-yard shovels, all Northwest. A rock picker of revolving trommel type, made by the Crook Company, of Los Angeles, is pulled by one of the tractors, as are tandem sheepsfoot rollers used in compacting embankments.

Practically all of the 2,550,800 cubic yards of excavation specified in the contract had to be hauled. A rock hill of about 600,000 cubic yards had to be blasted and hauled away from part of the desilting site. Three to five feet of light top soil had to be removed from a portion of the site and a million cubic yards of selected material brought from a borrow pit 2½ miles away to construct various compacted embankments which form desilting basins and channels through the area. Dirt excavated at various points about the dam itself had to be moved. To save wear on tires, and on the equipment in general, smooth operating roads were constructed and maintained and sprinkled daily. Loaded by one of the Northwest shovels, the 14-yard semi's and the 8-yard end dumps shuttled back and forth over the road from borrow pit to fills at 30 miles per hour. They had the right-of-way over all other traffic and unauthorized vehicles were excluded from the road.

It was soon found that oil dilution was causing a serious loss of power and excessive repairs, so early in the operation most of the equipment was changed over to burn butane gas, and at this writing all except the dragline is using this fuel. "We get twenty per cent more power and motor repairs have been cut in half by elimination of dilution," said Mr. Rieger, office manager. "Oil lasts twice as long. About the same quantity of fuel is consumed but it costs only 7½ cents per gallon, whereas the price of gasoline was 14.44. With the shovels, which previously burned fuel oil, at about the same price as the butane, advantages of the change lie in increased power and speed. All the other equipment had been burning gasoline."

Cost of changing over the trucks averaged $145 each, and involved planing off the motor heads 1/16 inch on a lathe, separating the intake from the exhaust, grinding the valves and replacing the gasoline tanks with butane pressure tanks. These hold 42 gallons, an ample quantity for a 7-hour shift, and are installed under the seats. The valves of the Allis-Chalmers tractors were ground, carburetors exchanged and pressure tanks installed in place of the gasoline tanks.

New high-compression heads were put on the Twin City motors of the shovels and the valve action was



Above, welding sheepsfoot roller prongs. Below, the butane tanks.

reversed by installation of high lift cams. A 300-gallon butane tank was mounted at the rear of the machine, on projecting angles, and secured to the cab by straps.

A 1000-gallon specially constructed pressure tank, mounted on an International truck chassis and equipped with a Harman-Pacific pump, driven by power take off, is used to service all equipment in the field with butane from two 10,000-gallon storage tanks located by a railroad spur near the company shops. Butane is transferred from the storage tanks with a Bassler electric pump, through a loading hose. All the butane tanks used are of welded construction, built by the Lacy Manufacturing Company, of Los Angeles, for the Parkhill-Wade Company, painted with aluminum.

Both new and re-conditioned truck engines are broken in on the job. Previous to changing over, an S.A.E. 50 breaking-in oil was used. With butane, dilution was eliminated and lighter breaking in oils could be used and an S.A.E. 10-W is now used until consumption is noticeable, when a change is made to S.A.E. 20, and later on to S.A.E. 30, as consumption increases. It was found that the use of lighter oils eliminated motor troubles experienced with the use of the heavy oil. At the same time, changes in lubrication methods were made which did much to reduce high transmission temperatures in hot weather and prevent excessive wear on other moving parts. Exhaust pipes were moved away from near the transmission and the lubricant was changed from S.A.E. 250 to S.A.E. 90. The result was a lowering of transmission temperatures (which had often reached 290°F) by about 20 degrees.

The hoists on the trucks were using about 5 gallons of oil during two 7-hour shifts, with seals and glands in normal condition. S.A.E. 50, a heavier oil, was substituted during summer, reducing consumption to about 2 gallons in the same period. With the coming of cool weather S.A.E. 20 proved to be the best for efficiency —a lighter oil than had been used at first. It was decided to pack the truck wheels with a wheel-bearing grease having a melting point above 300°F. This lasts so much longer, and excludes dust so much better than the regular chassis lubricant, that it has proved more economical, even though the original cost is nearly double that of the chassis grease.

A crew of five men attend to lubrication of trucks and tractors. Drive lines are lubricated at the end of each 7-hour shift and once every 24 hours a thorough lubrication is given, the check including motors and transmissions. Two well equipped grease pits at the oil house, near the shops, are used for this purpose. At the same time a general inspection is made and running repairs or replacements needed are marked up on a blackboard at the shop.

Repairs or adjustments of butane fittings are assigned to one particular mechanic, with butane experience. Both electric and acetylene welding is employed extensively in the upkeep of equipment. The gooseneck on the semi's is subject to severe strain, and new angle plates have to be welded in place where they join the dirt body. The curved under-side of the neck is usually strengthened by bending a section of 1-inch plate to fit and welding it in place. The hitch end wears rapidly, and is built up by welding on sections of 1-inch round steel, bent to fit. Fleetweld 3/16 rod is usually used in making this type of repair; also in repairing the prongs of the sheepsfoot rollers, which also wear rapidly, and a supply of new prongs is kept made up from sections of 2x¼-inch angles, welded together and with a square block of 1-inch steel welded to the end. These blocks have been heat treated and simplify repairing the prongs (which are built up in some shops with mild steel and then hardfaced). When the end of the prong is only slightly worn, it is trimmed with the cutting torch and a block welded on. If necessary, the prong is cut loose and replacements welded on.

A general overhaul of the shovels was made when they were in the shop for changing to butane. The abrasive nature of material handled wears the dippers quickly. The lip of one dipper was rebuilt by welding on a 1½-inch steel plate with Fleetweld 3/16 rod, and then hard facing it with Abrasoweld rod. Cracks were welded with stainless steel. Idlers and sprockets were built up where worn with "Hardweld" and small sections of ½-inch steel plate were welded over the holes in the sides of the sprocket wheels, to keep out rocks, and give added strength. The bumper block on the other Northwest was repaired by welding on, with continuous bead, a plate of ¾-inch steel. The adapters were rebuilt by welding on pieces of plate cut from a grader blade, and hard faced with Abrasoweld.

James Fogg is general foreman for the Condon company, Jack Rieger, office manager, and Harold Cummings, shop foreman. R. M. Conner is construction superintendent for the Morrison-Utah-Winston Company, general contractors on the dam and desilting plant, which is being built by the United States Bureau of Reclamation. Roy B. Williams is construction engineer for the bureau on this job, as well as on the All-American and Gila Canals. J. K. Rohrer is resident engineer at the dam and desilting works, assisted by Don M. Forester.

Highway Subgrade Treatment Methods in California

HIGHWAY construction in California during the year 1936 was featured by the preliminary treatment of the subgrade, prior to the placing of the pavement, particularly for asphalt concrete and Portland cement concrete types. The improvement of both the foundation and the immediate subgrade are of very great importance, and too much emphasis can not be placed upon them. A brief description of the methods, as reported by Earl Withycombe, assistant construction engineer, is given below.

Grading and Pavement Foundation

The roadway should rest on an unyielding foundation in order to secure best results. Insecure foundation conditions are largely the result of subsurface saturation, and wherever possible, areas which can not be readily drained and corrected are avoided in the location stages of highway design. It becomes necessary, however, at times to construct pavements over isolated areas of this description, and by means of boring tests the extent of such instability is approximately determined. Once determined, it becomes a question of economics as to the proper method of correction.

The methods used in California, listed as to their feasibility and order of consideration, are as follows:

(1) Dewatering by gravity flow induced by subsurface drains
(2) Removal and replacement of the unstable material
(3) Building of an embankment strut between the unstable mass, if dry, and an adjacent stable geological structure
(4) Construction of a stable roadbed by means of a systematic overloading of the roadbed area to obtain displacement of underlying mud and followed by removal of surplus overload to the planned elevation
(5) The construction of vertical drains for dewatering underlying mud

The first four of these methods are in quite common use by highway engineers. It has become general practice in California construction to supplement methods (1) and (2), wherever rock is available, by excavating a toe trench to solid foundation on the lower side of the unstable area and backfilling with as coarse rock fragments as are available. This type of submerged gravity rock toe wall is particularly effective under a variety of conditions.

Method (5) is particularly worthy of description, as it is comparatively new and was originated by the California Division of Highways. This method consists of sinking a large diameter well casing to the bottom of the unstable area and as the casing is removed, filling the hole with a porous and granular aggregate. The spacing of the vertical drains must necessarily be on rather close centers, which makes the method rather expensive. On the limited experimental sections constructed to date, it would appear that the rate of consolidation of the unstable material under the load of the superimposed roadway is greatly accelerated, and if sufficient time can be permitted between the construction of the roadway and the final paving, distortion of the riding surface may be minimized. Lateral movement of the unstable area during consolidation, however, may decrease the effectiveness of this method, and reasonable care must be exercised in the construction. It is necessary to connect the tops of the vertical drains, by means of porous subdrains, to a convenient outlet.

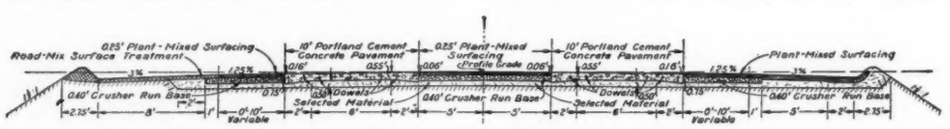
Stabilization of Subgrades

Stabilizing of subgrades is generally accomplished with a blanket course of suitable material and of sufficient depth to distribute the load to limits well under the maximum bearing power of the underlying materials. Where suitable blanket material is difficult to obtain, consideration is given as to whether an admixture can economically be added to the native soil, or the road relocated in a more favorable locality.

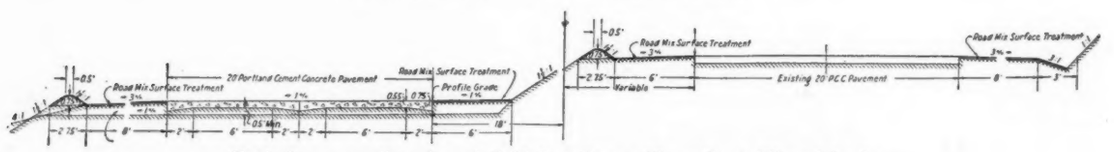
Even the most economical of foundation treatments is an expensive procedure and has resulted in considerably increased cost of construction. In general, however, the decrease in subsequent maintenance expenditures and the increased convenience to the traveling public have adequately justified the added expense.

Asphalt Concrete Construction Methods

Mr. Withycombe reports a decided improvement in the average riding qualities of asphalt concrete during the past season, this being largely due to the improved



Three-lane roadway with variation in surfacing of lanes. Convertible into divided 4-lane roadway by addition of lanes and conversion of center lane into separation strip.



Typical cross section plan of divided roadway with roads at different levels.

These illustrations show typical practices of the California Highway Department.

equipment used to spread and to roll the mixtures, to the use of better methods in straightedging, and to better-trained personnel. Contractors have generally discarded obsolete equipment and provided the latest improvements when replacements were made. The marking straightedge, similar to that described in the February, 1937, issue of California Highways and Public Works, has been generally used throughout 1936.

The large amount of asphalt concrete pavement laid during 1935 gave construction personnel a wider training in laying this type of pavement, and that training was reflected in the 1936 work. It was found necessary to increase asphalt contents to compensate for the inert asphaltenes which are disclosed in the petroleum ether solubility test. These increases in asphalt are contributing to the workability of mixtures and likewise aiding in obtaining smoother riding pavements. The increased asphalt should insure a longer service life in this type of pavement.

Details and Records of Construction

Interesting information on details and on construction records are included in the report. In joint construction, of Portland cement concrete roads, all transverse joints are doweled with ¾-inch round steel bars on 14-inch centers. The only other steel used is the ½-inch square reinforcing bar fixed by chairs driven into the subgrade to support each end of the dowels, and the longitudinal tie-bars at selected locations. Wherever subsequent movement was anticipated in high embankments, tie-bars were used across the longitudinal joint consisting of ½-inch square bars in longitudinal weakened plane joints, and threaded sleeve-connected ¾-inch bolts placed along longitudinal construction joints.

The joint interval was almost uniformly 20 feet, with provision made for ½-inch expansion at each 60-foot interval.

Concrete Mixtures

Of the 1936 mileage, 49% was constructed with 5 sacks of concrete to the cubic yard, representing a considerable reduction in cement content. Provision was made in the specifications to blend fine sand with the ordinary commercial product, but on only one job was this found necessary. These mixtures are somewhat harsh, but it was demonstrated that excellent results could be obtained with such reductions in cement.

The vibration method of placing concrete was set up as an alternate method in the specifications, but no contractor has seen fit to avail himself of this opportunity. An attempt was made to substitute vibration along the side forms in lieu of spading by means of trailing individual units over the surface adjacent to the side forms, but this proved to be unsuccessful.

Strongest Concrete

The strongest concrete placed during 1936 was on the Anaheim-Spadra Road. It had an average compressive strength of 5570 pounds. C. R. Butterfield was the contractor and H. B. Lindley, resident engineer.

Out of a total of 134,900 cubic yards of concrete pavement laid, 69,270 cubic yards, or 51.3%, was Class "A" mix, with an average strength of 4550 pounds, compared to 4965 in 1935. Four large pavement projects used 65,628 cubic yards of Class "B" concrete, being 48.7% of the total yardage placed, and having an average strength of 3740 pounds at 28 days.

Construction Records and Cement Control

The maximum average daily output of Portland cement concrete pavement, reduced to an 8-hour comparative basis, was placed near Cordelia, by Hanrahan-Wilcox Co., 690 cubic yards being produced by two pavers. A. N. Lund was the resident engineer with L. E. Ford as street assistant. The maximum output for one paver was 463 cubic yards per day, Seal Beach to Newport Beach, Geo. R. Curtis Co., contractor, W. D. Eaton, resident engineer. The average daily output for the State during 1936 was 385.7 cubic yards, compared to 343.3 cubic yards in 1935.

The record for cement control was made on Little Sycamore Canyon-Encinal Canyon road, with an average variation of 0.44%. Oswald Brothers were contractors, C. N. Ainley, resident engineer, with G. H. Lund, street assistant. The average variation for the State was 0.85%, compared to 0.93% in 1935.

Surface Smoothness

The record for surface smoothness was obtained near Fort Tejon, where the average roughness per mile was 4.9 inches. The contractor was the Griffith Company, F. M. Reynolds, resident engineer, and C. C. Hinsdale, street assistant. The average for the State was 12.1 inches per mile, compared to 9.3 inches in 1935. During 1936, the smoothest and the roughest riding qualities were encountered on projects constructed with 5-sack concrete, which seems to indicate that especial care must be exercised with reduced cement content mixtures in order to get good results. With the elimination of one such Class "B" rough project, the average roughness for the year is reduced to 9.0 inches per mile.

Construction Records on Asphalt Concrete

The maximum daily output of asphalt concrete was obtained near Vacaville, by Union Paving Co., 694 tons being produced per 8-hour day. A. K. Nulty was the resident engineer with E. D. Bulton as street assistant. The average daily output for the State was 447 tons during 1936, compared to 520.5 tons in 1935, the reason for the decreased average tonnage being the increased number of small projects.

The highest average stability of surface mixture was 3550 pounds, obtained near Newhall, by George R. Curtis Co., contractor; E. L. Seitz was resident engineer with A. W. Carr, street assistant. The average stability for the State was 2650 pounds, compared to 2908 pounds in 1935. This job was also the smoothest asphalt surface, with 11.4 ins. per mile. The State average was 14.7 ins., compared to 21.1 ins. in 1935.

The densest surface mixture was placed near Sunland, with a relative specific gravity of 97.7%. Southwest Paving Co., was the contractor and M. H. Mitchell, resident engineer. The State average was 94.3%.

The mileage of road-mix surfacing again predominated in 1936, there being constructed some 126 miles of this type as compared to 82 miles of plant-mix.

The record for surface smoothness of plant-mix, 14.2 inches per mile, was made in San Bernardino County, contractor, George Herz Co., and resident engineer, G. E. Malkson. The average roughness index for the State during 1936 was 33.5 inches per mile, compared to 36 inches in 1935.

For road-mix type, the smoothest surface was obtained in Inyo County with 12.1 inches per mile. The contractor was Basich Bros., and resident engineer, A. C. Briney. The average roughness index for the State during 1936 was 30 inches per mile, compared to 37 inches in 1935.

A Digest of Current Sewerage Literature of the Month

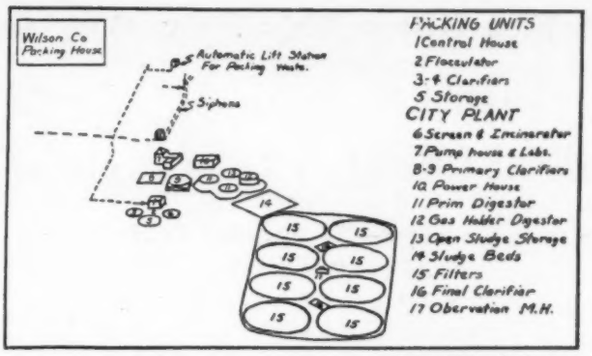
The Digestion Tank

Industrial cooperation with the municipality in treating wastes is an outstanding feature of the Cedar Rapids, Ia., plant. Population 55,000; wastes from meat-packing plant equivalent to 48,000 to 181,000, average 108,000. City sewage is screened and screenings burned, using sludge gas; sewage lifted 45 ft. to detritor; thence through air-blown grease removal tank, grease incinerated; thence to 5 primary clarifiers, one 70′ "Sifeed" and four 17′ x 65′ straight-line clarifiers; effluent to eight 167′ circular trickling filters, with four final clarifiers. Packing wastes pass through 60-mesh screens and grease traps at the plant and are pumped across the river to a pretreatment plant located adjacent to the city sewage plant, consisting of a 360,000 gal. storage tank to take care of high daily peak rates, flow from which is governed by rate-of-flow controller; a cone-bottom cylinder-type air-blown grease remover; a flask-mix unit and flocculator; two circular clarifiers; and machines for feeding sulphuric acid, ferric chloride and lime. Effluent from this chemical precipitation plant is pumped to the main filter dosing tanks, or to the main clarifiers.

Final clarifier sludge is returned to untreated city sewage; other sludge goes to four 60′ circular digestion tanks, three covered, one used for open storage; thence to a vacuum filter or open sand drying beds. Gas is used in a 210 hp. generator unit, circulating water from which heats the digesters. (Sewage can be heated by condenser water from packing plant.)

The plant reduces B.O.D. from 422 to 62, yearly averages. Gas recovered, 138,000 cu. ft. a day, of which 14,000 is used for screenings, 81,000 for the gas engine, balance wasted or used for space heating; 3,000 kwh generated daily, of which plant uses 2,000 and 1,000 is sold to local electric company. Primary clarifiers average 65% removal of suspended solids. Filters effected 79.7% reduction of B.O.D. applied to them. Circular distributors gave distribution over entire area varying less than 5% either way from the average on any given square-foot area. Sloughing is continuous.[G23]

Flocculation, tested for two 30-day periods on raw domestic sewage at the Cedar Rapids plant, flocculated sewage flowing through one 50′ clarifier and unflocculated sewage through another, showed that "at least a 50% advantage in removal of suspended solids was accomplished by flocculation, provided the velocity between flocculator and clarifier was not sufficient to shred the floc." With packing-house wastes, very satisfactory results were obtained by passing raw wastes through a flocculator and a clarifier. Best results (40.6% B.O.D. reduction) were obtained when flocculating with ferric chloride and adding lime to sludge returned from secondary clarifiers; but flocculation alone gave as good results, and chemicals now are used only when loading is exceptionally high or for odor control on the filters.[G23]



Water Works & Sewerage

Sketch of Cedar Rapids Sewage Treatment Works

Sewage irrigation in Vineland, N. J., has been used to treat the sewage of 8,000 people and aid crop production on a sterile, coarse sand for 9 years past. After settling in a tank 60 x 100 ft. by 15 ft. deep, the sewage is run onto a 14-acre area. Different irrigation methods are used for the different crops—corn, onions, eggplant, etc. During fall and winter sewage is turned onto woodland or non-crop flatlands. In the coarse sand of the farm land, phosphorus is the only fertilizing element retained in the soil for any length of time when growing plants are not present. Sewage irrigated field corn yielded 70 bu. per acre and unirrigated but fertilized less than 7 bu. Liming with irrigation was generally advantageous. Sludge collecting in the settling tank is removed once or twice a year, and either plowed under or air-dried and burned. Total cost of plant, including land $146,472; operating cost about $600, but would be about $1,450 per year if no revenue was received from crops.[E17]

Oxidation of garbage-sewage mixtures was compared with that of sewage alone at the N. J. Agricultural Experiment Station, and the experiments indicated that garbage increases the B.O.D. of settled sewage but the material causing the increase is readily oxidized and at a rate equal to or greater than that of sewage alone; that the oxidation progresses as far or farther than that of sewage alone; that there is no interference in the stabilization of the effluents, as indicated by nitrate production; no interference or retardation on activated sludge over a period of a month; and the sludge did not materially increase in volume and was not more bulky than from sewage alone.[H65]

Heat treatment of sludge has been experimented with in Halifax, England, the sludge being heated by steam of 184° C. applied for 30 min. at 150 lb. pressure and pressed into cakes in filter presses. This destroyed colloidal properties so that the bulk of the water can be decanted, and drier cakes be obtained more quickly. But under heat treatment part of the solid matter, including the bulk of the organic nitrogen, goes into solution, producing a strong effluent which may need special treatment; that from activated sludge cannot be treated to produce a satisfactory final effluent by either single or double treatment by bio-filtration or activated sludge treatment, but can be by filtration followed by return to sewage flow.[D44]

Five-day B.O.D. was found to have a fairly uniform relation to the turbidity of a given sewage, and estimation of the B.O.D. by measuring turbidity gave a quick determination with not over 5% error. But the

relation differs with different processes and possibly with different sewages; and colored trade wastes affect it. At Burnley, England, 10 ppm solids in filter effluents is equivalent to 0.37 on the B.O.D. scale, but to 0.55 for aeration effluents. Suspended solids also can be estimated by this method quickly, and probably as accurately as by direct weighing methods. Light-absorption turbidimeters and photo-cell apparatus were used for accurate determination of turbidity.[D46]

The **Pruss tank** (or Simplex continuous-flow settling tank) at Dagenham is a circular tank 94′ in diameter, inside which are four concentric cylinders. The top of the smallest, 11′ in diameter, serves as the inlet weir. One foot outside this is a sheet steel baffle extending 4′ 6″ below the surface. The next cylinder is 22′ diameter, with a grid of bars spaced 1½″ apart to distribute the flow evenly. Then comes another similar grid 70′ diameter. This 70′ space is 8′ to 10′ deep, sloping toward a central hopper, into which the sludge settling here is swept by revolving scrapers. The outer annular space, 12′ wide, contains 3 hoppers spaced 120° apart into which the sludge settling here is swept. A revolving bridge carries the sludge removers, also a scum remover in the inner basin. With the detention period at 3 hrs. or more, the central sludge hopper receives at least 90% of the sludge, but at 1½ hrs. detention (the limit of satisfactory operation) it receives only about 50%. Normally each hopper is sludged once daily, but with high flows the central hopper is sludged twice daily and the outer ones three times. At the low flow the sludge averages 93% moisture, at the higher flows 95%. Before entering the tank the sewage passes through ¾″ screens and receives surplus activated sludge, adding about 100 to 300 ppm to the main sewage.[D45]

Trickling filter operation at Worcester Mass., includes weekly washing of dosing tanks and blowing out of all piping and cleaning and oiling counters in the tanks; weekly flushing of the 456 distribution laterals, and of the main distributors, and daily cleaning of nozzles, the number cleaned per day during the past nine years having averaged 15.3 per acre. The filters are never rested; pooling occurs only during a few weeks in the early spring and disappears without attention, and does not affect stability of effuent, which continues at 100% after the middle of March. But zero weather reduces stability to 55% some winters.[C46]

Oil pollution of harbor waters is well under control in Rhode Island. During 1936 nearly a billion gallons of petroleum were received at Rhode Island ports, but there was only one discharge of oil to the public waters of any consequence and this did not cause serious damage. Most difficult to control has been the pumping of bilge water into the bay by oil-carrying ships that are infrequent callers.[C48]

Bentonite for purifying sewage was tested on Iowa City sewage which had been passed through an 8-mesh screen. Using 50 to 100 ppm of bentonite reduced B.O.D. from 373 to 88 to 26 ppm; 80 to 90 ppm (700 lb. per million gallons of sewage) would give 30 to 40 B.O.D., equal to the effluent from the trickling filter and final clarifier. Presettling before using bentonite did not improve results, may even be of negative value.[G24]

Bibliography of Recent Sewerage Literature

c, Indicates construction article; n, note or short article; p, paper before a society (complete or abstract); t, technical article.

D
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41. *p.* Modern Trends in Sewage Disposal. By S. G. Wardley and J. A. Christian. Pp. 889-891.
42. Treatment of Dairy Wastes. Pp. 891-892.
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43. *p.* The Renaissance of the Percolating Filter. By H. N. Jenks. Pp. 5-7.

Turn to pages 55-57 for descriptions of helpful booklets and catalogs.

44. *p.* Experiments on Dewatering Humus and Activated Sludges. By C. Lumb and J. Hirst. Pp. 9-11.

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45. *p.* Operation of the Dagenham Pruss Tank. By A. H. Holroyd. Pp. 39-41.
46. *p.* Relationship Between Turbidity Measurements and B. O. D. and Suspended Solids Determinations. By W. Watson and E. M. Weir. Pp. 43-44.

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17. Municipal Sewage Irrigation. By G. A. Mitchell. Pp. 63-66.

G *Water Works and Sewage*

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65. Effect of Ground Garbage on Oxidation. By W. Rudolfs and R. S. Ingals. Pp. 356-358.
66. Ingenious Plants in South America. By E. B. Besselievre. Pp. 359-362.
68. Sewage Plant Operation: Screens and Grit Chambers. By W. H. Wisely. Pp. 363-365.
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71. When Pollution Causes Sickness. (Legal Decisions.) By L. T. Parker. Pp. 373-374.

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16. Sewage Screenings Incinerators. By A. E. Stilson. Pp. 65, 67, 69.
17. Admitting Trade Wastes to Sewers. Pp. 79, 81.

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3. Sewage Disposal Situation at Kitchener, Ont. By S. Shupe. Pp. 5-8.

July 6

4. Sewage Disposal Situation at Kitchener, Ont. By S. Shupe. Pp. 13-14.

July 13

5. Damages from Sewer Construction in Ottawa. Pp. 23-24.

P *Public Works*

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31. 97% Reduction of Pollution by Private Industry. P. 14.
32. *c.* Sewage Treatment Plant Construction in Treacherous Ground. By O. J. Semmes, Jr. Pp. 15-16.
33. *n.* Charging Sewer Rentals Held Valid. P. 16.
34. Practical Suggestions for Sewage Plant Designers. P. 21.
35. Largest Sewage Treatment Plant in the World Nears Completion. P. 33.
36. *n.* Forfeiture of Bidder's Deposit for Failure to Sign Contract. P. 54.

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April

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Sewer Contractor's Indemnity Contract

The contractor for the construction of a sewer for a city agreed to indemnify the city against liability "by reason of any act, omission or neglect of said contractor." Part of the work included was a tunnel under private premises. Without the sewer contractor's knowledge, the city acquired the necessary easement through the owners' lands and agreed with them, in the event of inevitable damage, to restore the buildings to their former condition. The contractor performed the work with extreme care and with no negligence. Necessary blasting caused inevitable damage. For this the city paid the owners out of a sum which it retained from the contract price. In an equity suit by the contractor against the city, Bryne v. City of Gloucester, 8 N. E. (2d.) 170, the Massachusetts Supreme Court held that the contractor was not bound to indemnify the city for the damage caused by the blasting.

When the city bought the easement rights from the landowners it acquired substantially the same rights to the lands which it would have acquired by a taking by eminent domain, and the landowners immediately acquired rights against the city which arose out of their agreements with the city and not "by reason of any act" of the contractor, who at that time may have performed no act. They acquired no additional claims against any one when their buildings were in fact injured by the blasting, except that a contingent of their agreements with the city then became operative, and they became entitled to recover from the city thereunder.

Traffic Accidents Reduced as Detroit Improves Lights

By MAURICE JUDD

Improved lighting, shown above, reduced traffic accidents.

THE city of Detroit, Michigan, is getting a completely rehabilitated municipal lighting system with the aid of labor supplied by the Works Progress Administration.

The Detroit municipal system had long been in need of improvements, and its managers had been unable to finance the making of connections to schools (which were being supplied by a private corporation), to make necessary repairs, to install new boulevard lighting systems, or to extend the system as would have been justified by the growth of the city.

During 1935, the Public Lighting Commission of Detroit sponsored three projects to correct these conditions, two of which were later combined in one. They were selected for operation in December of that year and were intended to accomplish several objectives, among which were the installation of a new boulevard lighting system and of "test" lighting systems at critical intersections with a view to minimizing night traffic accidents by better lighting. Also, the construction of complete underground conduit systems where metropolitan trunk arteries were being widened under State and Public Works Administration authority. This work included also all the underground work for the Street Railway Department, Fire Department, Police Department and Traffic Department.

Employing an average of about 730 men, the projects have, since December, 1935, been worked steadily so that by May 1, 1937, H. M. Stark, the area engineer, reported the following physical accomplishments:

Summary of Work Effected to May 1, 1937

Conduit line constructed	72,454	ft.
Manholes (conduit type)	249	
Handholes (conduit type)	263	
New lamp settings (Blvd. type)	624	
Tunnel work	8,529	ft.
Overhead lines (new)	63,493	ft.
Underground cable	57,960	ft.
Replace O. H. by U. G. cable	987	ft.
Painting street lighting poles	2,108	
Street lamps overhauled	9,538	
Substation equipment overhauled	15	
C. C. regulators rebuilt	45	
Substation interior painting	35,000	Sq. Yds.
Deion fuses installed	196	
Converted fixtures installed	402	
Service layouts to schools	23	
Manhole castings reset	33	

This work involved the use of the following quantities of materials, most of which were supplied by the sponsors for the projects:

Materials Used

Fibre conduit	471,000 ft.
Brick	786 M
Cement	15,615 Bbls.
Reinforcing steel	186 Tons
Stone	8,740 Tons
Sand	8,963 Tons
Cable	58,000 ft.
Paint	3,000 Gals.
Sewer pipe	6,000 ft.

By systematizing the work, the supervisors were able to stay well within the estimated unit costs as soon as their organization was trained, resulting in a surplus which was used to effect other improvements not originally contemplated.

One of these was the amelioration of conditions surrounding local "night accident" areas, or areas in which night traffic accidents were disproportionately high as compared to day accidents, the work centering itself on revamping circuits and installing new ones at crucial points. At the points where these safety lamps were installed, the project paid immediate dividends in the reduction of the proportion of fatal night accidents to day accidents from 7 to one before installation to 1¼ to one after installation, though the period of the latter is shorter than the former.

A typical trial setup of safety lighting which was installed at the Gratiot-Harper intersection is receiving close observance by representatives of national illuminating engineering associations. A 16-lamp hookup was installed at this major accident location, equipped with modern sodium lamps.

Some of the results of the safety lighting campaign may be observed from the accomplishment report. The two and three-quarters miles of Fort Street from West Grand Boulevard to Woodmere had a frequency of 15 fatal accidents by night and one by day for the years 1934 and 1935. For the period from September 1, 1936, to May 1, 1937, after installation of the lights, the accident frequency was one by night and none by day. The lights used here were G. E. types 81 and 88 fixtures with a lamp ratings lumens of 15,000, mounted to a height of 22 feet and spaced 100 feet to 135 feet apart.

The stretch of 4⅜ miles on Michigan Street, from Griswold to Fifth and from Fifth to Livernois, was mounted with equipment at 22 feet height spaced 55

feet and 75 feet from the center line of the street, staggered, consisting of Westinghouse Form 88 with a lamp ratings lumens of 10,000. Here, the frequency of fatal accidents in 1934 and 1935, 21 by night and 5 by day, was reduced to one by night and none by day in the period from January 1, 1937, to May 1, 1937.

Altogether, 14 such installations were made, with a total mileage of 31. Along the routes of these various installations for the period of 1934 to 1935 there had been 111 fatal accidents by night and 16 by day. After installation, for various periods ranging from September 1, 1936, to May 1937 to January 1, 1937, to May 1, 1937, the frequency of fatal night accidents was five and of fatal day accidents four.

Rat Control Methods in Hawaii

Because of the possibility of plague, close control of the rat population in Hawaii is deemed necessary. On the Island of Maui, A. L. Dopmeyer, sanitary engineer, reports that, in addition to trapping, the following methods were used in the open country:

(1) Clearing heavily rat infested areas by cutting out the rat's natural food supply consisting of various kinds of wild beans, berries, seeds and fruit.
(2) Burning of the brush and other material cut down.
(3) Killing rats in the burrows exposed by the above measures, by applying carbon bisulphide and igniting.
(4) Applying poison bait to cleared areas.
(5) Applying calcium cyanide to rock walls and rock piles.
(6) Clearing algaroba forests of underbrush to prevent rats from building nests in the trees.

The effectiveness of these measures was demonstrated by the reduced rat catch in the zone where the work was first carried out. The rate of catch in this area was from 8 to 10 rats per hundred traps per day and there was no reduction during the intensive poisoning campaign carried on in 1933 and part of 1934. When the above measures were instituted, there began a gradual drop in the rate of catch from month to month and after thirteen months' operation the rate was down to 0.67 rats per hundred traps per day.

In the beginning of the year the trappers in and around the Makawao region devoted their time, after setting their traps, to treating burrows with carbon bisulphide. During the latter part of the year a campaign was started to rat-proof buildings. Trappers also began work in Kahului and the adjoining built-up areas. The work of these men consisted of rat-proofing by elimination, i.e.; removing wood floors that were too close to the ground; removing out-houses and other buildings which were not being used, and which were beyond a state of repair, affording rat harborage; and removing lattice work, vines and any other material around buildings which might harbor or aid in harboring rats. This work was well under way by the end of the fiscal year and excellent results were being obtained.

In the Island of Hawaii, 17,696,129 packages of poison bait were placed in fields, gulches and buildings. It is felt that poison bait is still the best method of control but that more attractive baits than wheat and barley must be developed. The research laboratory of the Federal Rat Abatement Project, located in Honolulu, has

done some work on developing a meat bait made up in the form of a sausage. Meats used have been ground beef, bacon and salt pork with pot barley and breakfast oats added. Several field tests of these baits were made, acceptance being very good. These tests have not been on a large enough scale to determine the effectiveness of the dose of poison contained though the poison content is much greater than what has been used in the past in grain baits. Extreme caution must be taken in placing this type of bait for the reason that meats are attractive to other animals beside the rat.

"We feel that a bait of this type will probably prove the most efficient, providing it has a sufficient amount of poison in it to kill without the rat having to eat the entire package, for after all, with the amount and kinds of food that are available to the rat, we must bear in mind that we are not dealing with a hungry rat, but with one that, when it finds the bait, has already had a meal and it need eat only a small portion of the bait in order to get a lethal dose of poison. In other words we should endeavor to give the rat a 'dessert,' and in order to do this the bait must be very attractive so that it will be acceptable."

Distillery Waste Troubles in Maryland

Nine distilleries located in several counties of the State of Maryland and discharging, without treatment, part or all of their wastes into the streams near which they are located, was the major industrial waste problem of that State in 1936. These distilleries operated at full capacity during most of the year, producing a total daily volume of waste in excess of 450,000 gallons. During the months of September, October, November and December, production was decreased in most of these plants, thereby reducing the waste load about 20 per cent, and during this period there was a marked stimulus in the removal of waste by farmers, either without cost or at a slight charge.

One distiller has arranged a three year contract to sell 10,000 gallons of slop per day to a company said to be experienced in fattening hogs on whole slop properly supplemented by other feed. The location of the piggery is in an isolated area and the waste is conveyed thereto by pipe line from the distillery. At the close of 1936 construction of the piggery was about completed. The construction and layout of pens and the method of operation as outlined were reported by the State Department of Health as appearing to be satisfactory.

A representative of the Bureau of Sanitary Engineering assisted one distiller in stimulating interest in the feeding and fertilizer use of distillery waste among about 200 farmers operating within a radius of 10 miles of the plant. This distillery succeeded in giving its entire waste output to farmers during November and December. Two distilleries are operating evaporators, one triple and the other quadruple effect. Each installation is being operated in single phase with more or less difficulty due to the "gumming" peculiar to rye slop. Considerable amount of laboratory study has been made to eliminate the gumming characteristics of the waste and one of the distillers will install a type of preliminary treatment designed to overcome this difficulty. It is the opinion of the Bureau, as stated in its annual report (from which the above information was obtained) that as long as the "removal by farmers" method is the predominating type of disposal, the solution of the distillery waste problem will be, at most, sporadic and temporary in character.

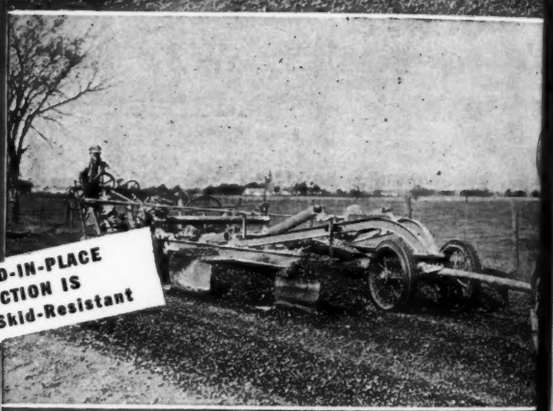
KOPPERS Tarmac

SURFACES ARE SKID-RESISTANT

TARMAC PENETRATION CONSTRUCTION IS Skid-Resistant

TARMAC DRAG LEVELING COURSES ARE Skid-Resistant

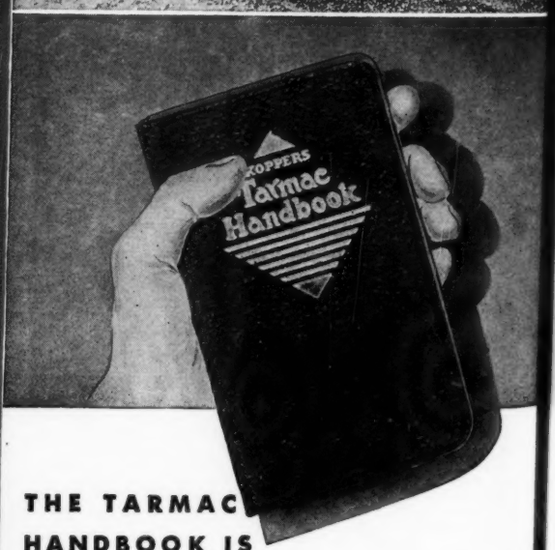
TARMAC STABILIZED SOIL SURFACES ARE Skid-Resistant



TARMAC MIXED-IN-PLACE CONSTRUCTION IS Skid-Resistant

TARMAC SURFACE TREATMENTS ARE Skid-Resistant

TARMAC MULCH TREATMENTS ARE Skid-Resistant



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This 63-page book contains complete tables and other useful information about construction and maintenance with Tarmac, as well as condensed specifications for every type of construction. Send for a copy.

FOR BEST RESULTS USE KOPPERS Tarmac

"Dear Mr. Timewaster"

Dear Sir:

In Opie Read's "The Jucklins," which I read thirty years ago, old Lem Jucklin said that he believed in the Bible from "kiver to kiver," but that he just couldn't help "fightin' chickens." (He was a devotee of the sport of game cock fighting.) I might say that, though I am kept quite busy by the duties of my office and by other business, yet I just can't help putting in some time on "TIMEWASTERS."

I enclose herewith a solution of Mr. Bevan's Huntingdon-to-London problem appearing in the June issue of PUBLIC WORKS. I especially liked this problem on account of the challenge it made to my ability to find the means of approach to a solution. Yet, once solved, it all appears simple enough.

I enclose also a solution to Mr. Blunk's problem.

Very truly yours,

JAMES A. VINSON.

Eddyville, Ky.

Dear Sir:

As usual the first thing looked at in your magazine is "Timewasters" but failed to see the solution of the color blind problem, so I will give you my conception of it:

Painter is Gray, Aviator is Green, Doctor is Black, Clerk is Brown and the Salesman is White.

There is no question as to Black being the doctor; Brown is the clerk as he performed the duty of a clerk when he confirmed the order of Green the aviator for Gray to paint his plane green, this eliminates all but White who must be the salesman.

I get a lot of information out of Public Works every month and its coming is gladly welcome.

Yours truly,

W. H. McFARLAND.

Hart, Mich.

Dear Sir:

I intercepted your SOS call in the April issue for the 9-11 problem for the benefit of Mr. Reichstein, et al.

I find when delving into the litter that covers what I used for a mind in the gay nineties when in school, that my remembrance of permutations is rather sketchy. For that reason I will not be offended if some more recent students take exception to the following theories, theorums and results. Anyway here goes:

Since the number—123456789—is divisible by 9 in any of its 362880 permutations (since the sum of the digits will always be 45 which is divisible by 9), the problem is: which one or ones of those 362880 permutations are divisible by 99 (9 and 11 being prime to each other).

Of course we could "Permutit" (excuse 330 W. 42nd St.) and apply the old long division method to the permutations, but that is strong arm work.

Now take any number of 9 digits, as 789123456; consider it thus

```
7 (89) (12) (34) (56)
:   :    :    :    :  .....56
:   :    :    :  ......34
:   :    :  ........12
:   :  ..........89
:  ............7
                2/Sum 198
                  99
```

Or take

```
7 (89) (12) (34) (65) (one change)
:   :    :    :    :  .....65
:   :    :    :  ......34
:   :    :  ........12
:   :  ..........89
:  ............7
                99/Sum 207
              99×2=198
              Remainder 9
```

Of the two, the former IS divisible by both 9 and 11 and the latter is NOT. Otherwise in every 100 there must be an exact number of 99's.

We further note that the unit column of every addition as illustrated above will add 28 if the sum is divisible by 99. (This applies to 9 digit numbers.)

Now we have to discover all possible arrangements of the digits from 1 to 9 inclusive (which if placed in the unit columns will add just 28 and no more. This is comparatively simple and results in the following primary permutations:

1-3-7-8-9
1-4-6-8-9
2-3-6-8-9
2-4-5-8-9
1-5-6-7-9
2-4-6-7-9
3-4-5-7-9

Now each of these is subject to 120 permutations, and each of the other numbers to fill the blanks (4) is subject to 24 permutations so we have in all 120x7x24 possible solutions or 20160. This could have been determined from the original 362880 permutations (9x8x7x6x5x4x3x2x1) by dividing it by 2x9 (number of groups times number of terms) BUT would not have determined the exact numbers that are divisible by 11.

Now it does not matter what digit is placed in the space indicated by—above the resulting 9 digit number will be divisible, I mean of course any digit that has not been used in the same number; no digit may be repeated in the same number and all nine must be used to comply with my understanding of the problem.

To expand one of the above to show possible arrangements:

13789	17389	18379	19378
13798	17398	18397	19387
13897	17839	18739	19738
13879	17893	18793	19783
13978	17938	18937	19837
13987	17983	18973	19873

In like manner each digit may be taken first making 5x24 or 120 permutations for each group x7 groups, 840 in all before the other 4 numbers are inserted. Then each group is subject to 3x2x1(6)x4 further permutations making the total as given above 20160.

To illustrate: (bold numbers the original, roman inserts)

123475869
143572869
153274869
163275849
etc.

Each number fulfills the requirements of being divisible by 11. And so on for the rest of the 20160. I didn't prove all of the 20160 but the skeptical may do so.

The method of determining divisibility by 99 is mine; it may not be Hoyle and again it may be standard, I never saw it given in any book.

Trusting this may cause some one a means of wasting time, I will now devote my attention to the eggs (was that rate per each or per some fractional part of the whole number?)

Sincerely yours,

FRED D. PRICE.

Plymouth, Ind.

Dear Sir:

The Timewaster column in the last issues of PUBLIC WORKS have been mighty interesting in that the problems have an appeal to your average reader who is not a cold blooded mathematical shark.

In the April issue there is a peanut problem to which the following answer is submitted (by the way, Mr. Goober probably was given the empty sack). Mrs. Goober kept 19 peanuts for herself after giving the oldest boy 160, the youngest boy 40, the oldest girl 80 and the youngest girl 20. The boys received 200 and the girls 100.

If you are in need of problems for use in the Timewaster column, the following may be of interest to some of your readers. Five men, whose names are Black, White, Grey, Green and Brown have the following occupations, painter, aviator, doctor, clerk, and salesman. Determine the men's occupations from the following data. "While the salesman was under the care of Doctor Black, Grey, who is not a clerk, asked Brown to take a confirmation of an order from the aviator who wanted his plane painted the same color as his name."

In the solution there will be two unknowns, but White not being a color gives the following answer: Painter Grey, Doctor Black, Clerk Brown, Salesman White and Aviator Green.

Would you kindly forward the solutions to the match problem and also the nine dot problem which you offered in the April, 1937, issue.

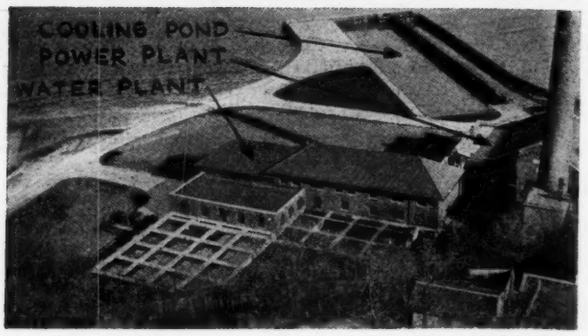
Very truly yours,

CHAS. W. MANLY.

Fresno, Calif.

The Water Wheel

A Digest of Current Waterworks Literature



From Journal AWWA

Aerial view of water and electric plants, Winnetka.

Winter filter operation at Winnetka, Ill., was made difficult by ice, which in 1936 was 20″ thick at the inlet of the coagulating basins and 22″ at the outlet, 4″ thick on the rapid sand filters, and 7″ at the outlet of the filtered water reservoir. Adjacent to the plant was a municipal power plant with condenser equipment. During freezing weather condenser water was bypassed to the water works intake pipe, thus warming the water; condenser water so used equalling 35% to 80% of the 2 mgd rate of pumpage to the filtration plant. The ice in the open coagulating basins was gone 72 hours after this was begun, and in the filtered water reservoir 96 hours after. The condenser water was analyzed and found satisfactory for water plant use, but as a precaution the alum dose was increased from 0.8 to 1.1 grains per gal., prechlorination used at 4 lb. per million gallons, and activated carbon at 20 lb.[A117]

Sand tanks are numerous in Arizona, mostly for storing water for ranches or other non-municipal consumers. A dam is built forming a reservoir and this fills up with sand and gravel washed down by the stream. This contains about 25% to 30% voids. That climate makes it "almost imposible to conserve water in any type of open pond or reservoir." With the sand tank, evaporation losses are much reduced; and water is not contaminated by animals or insects. The sand is too coarse for capillary attraction to act. Some of these have been in use for over 100 years.[E32]

Steel pipe wall thickness necessary to resist corrosion on the outside will vary with the nature of the surrounding soil. The National Bureau of Standards, American Gas Ass'n, American Petroleum Institute and others have studied soil corrosiveness over a long period and developed a relation between certain soil characteristics and the rate at which pits will penetrate the steel. On the basis of this, it is thought possible to calculate the thickness of steel required for a pipe to last any given number of years in a given soil. Effect of coating is considered to be to delay the beginning of pitting for a certain time—a "coating corrosion index" is the difference between the depth of the deepest pit on a coated pipe and an uncoated pipe, respectively, measured in mils (0.001 inch). The formula for thickness is

$$W = k\,T^{n}\,F\,\frac{1}{F} - C$$

in which W is wall thickness in mils for period of exposure T in years; k is average maximum pit depth (mils) on 0.4 sq. ft. at one year for the given soil; n varies from 0.2 for least corrosive soil to 0.92 for most corrosive; F varies from 1.63 for 1″ pipe to 2.80 for 36″; and C is the coating corrosion index.[A109]

An 18.6-mile tunnel was built in a little over 7 months by Charleston, S. C., to bring to that city 50 mgd additional water, to carry out a contract to furnish a paper company with 25 mgd or more, beginning 12 months later. Headings were driven from 17 shafts and 2 portals, through marl in some places soft enough to be excavated with air spades. The cover is in general 40 to 60 ft. Tunnel is horseshoe section 40.5 sq. ft. area; falls 19 ft. in 23½ miles (including a tunnel built previously), giving estimated capacity of 50 mgd which can be increased to 75 mgd by pumping. Tunnel is unlined, as in a short tunnel in the same material filled with water for 8 yrs. the marl had hardened rather than deteriorated. Final heading holed through Feb. 24, 1937.[E33]

Silicates aid coagulation of water with aluminum sulphate, is the opinion of Mr. Baylis, derived from his observations and experiments and a study of results obtained by others. "Adding silica in a certain form to water causes the coagulation to be produced more rapidly than it otherwise would be produced. Also, the added silica produces larger flocculated particles, which are not so easily broken up by agitation as are the coagulated particles where no silica is used." And therefore the coagulated matter "is removed more effectively by the filters." Experiments show that "the addition of silica to water will be well worth its cost in at least a few filtration plants." "The compound of silicon which gives aid to coagulation is not known definitely, though it is believed to be a colloidal hydrous silicon dioxide possessing a strong negative charge."[F80]

Well development by dry ice has been used successfully in San Jose and Orland, Calif. In Orland a well yielding 60 gpm with 85 ft. drawdown increased to 800 + gpm with 15 ft. drawdown after use of dry ice. Dropped into the well, dry ice falls to the bottom, changes to gas exerting sufficient pressure to blow the water 30 ft. into the air above the well, and repeated these explosions several times as water flowing into the well alternately filled it and was blown out. This action forces water back and forth through the screen openings, washing the clay and fine sand out of the surrounding water bearing stratum. Five hundred pounds of dry ice was applied in three charges to the 14-inch well at Orland.[F82]

Air conditioning was the subject of six papers in the June Journal of the A. W. W. A., all of which are considered together in the following abstract. The Chicago "loop" area last fall contained 395 air-conditioning

Showing installation of 72" I.D. Dresser-coupled mains between tank and coagulating basin at the Cincinnati water purification plant.

Big ones at CINCINNATI!

ON LINES OF EVERY SIZE!

Lines of all diameters are being Dresser-coupled in cities like these:

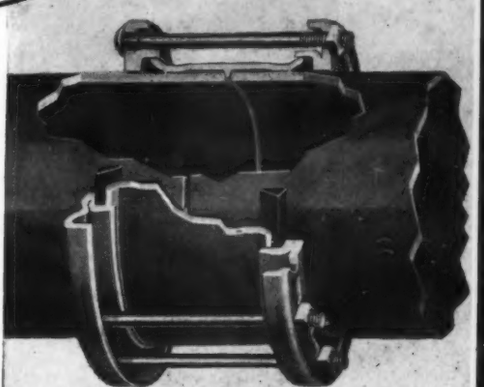
Danville, Ky. Ironwood, Mich.
Ferndale, Wash. New Brunswick, N. J.
Fort Smith, Ark. Ponca City, Okla.

As great in diameter as a six-foot man is tall, are these Cincinnati twin raw-water mains, constructed during 1936 at the water purification plant and joined with Dresser Couplings. A few years before, another Cincinnati water line (48") was also Dresser-coupled.

FIVE REASONS WHY MODERN WATER LINES ARE DRESSER-COUPLED:

1. PERMANENT TIGHTNESS—proved for 50 years, on 150,000 miles of pipe.
2. FLEXIBILITY—normal pipe movements—present in every line—are absorbed.
3. SIMPLICITY—joints are "factory-made"; ordinary labor can install.
4. STRENGTH—predetermined; joints safely withstand any specified pressure.
5. TRUE ECONOMY—a truly lower joint cost throughout the life of the line.

Write for our General Catalog No. 36.



Cutaway view of Dresser Style 38 Coupling, showing working principle. Note that plain-end pipe is used. The resilient gaskets, flexing with the pipe, safely absorb pipe movements.

THE MODERN TREND IS TO DRESSER COUPLINGS

S. R. DRESSER MFG. COMPANY, BRADFORD, PA. • *In Canada:* Dresser Mfg. Company, Ltd., 60 Front St., W., Toronto, Ont.

installations with a total refrigerating capacity of 11,865 tons, requiring water at a rate of 34 mgd, but was only 16% air conditioned. Complete service for the district would require about 300 mgd., requiring large investment in pumps, mains and sewers which would be used for probably only 1,000 hours a year. Already the sewers have been so overtaxed as to back up and flood basements. But if all the plants should be provided with water conserving devices, only about 5% of this amount of water would be needed, and 100% air conditioning would require only half the water now used for this purpose.[A110]

For air conditioning, chief use of water is by the condensing unit which condenses a gas or vapor to remove its latent heat of vaporization. Freon is the most commonly used refrigerant. Using mimimum amount of water, a 15 hp machine using 600 gph of 70° water would discharge it at 110°, which might not be permitted in the sewers. Lower temperature could be obtained by using more water. Less consumption is obtainable by cooling water in spray ponds or towers or in forced draft towers, continually recirculating the water. When water and steam are cheap, the steam jet vacuum plant is attractive. For summer dehumidifying, well water is seldom successfully used alone for direct cooling unless below 55°, or in conjunction with supplementary low-temperature freon coils. Self-contained water-cooled room coolers average about 30 gph of 70° water. By reverse refrigeration, 50° water in winter can be used for heating.[A111]

On Jan. 1, 1937, water conditioning equipment had been installed for 14% of the population of Houston, 12% of Kansas City, 10.6% of St. Louis, 9.5% of New Orleans, 2.5% of Brooklyn, N. Y., 3.5% of Boston, 8.9% of Manhattan and Bronx Boroughs; Washington, D. C., leading with 40.5%.[A112]

Ground water, to be satisfactory as a direct cooling agent, must be at 55° or lower; with higher temperatures the volume required is very materially increased.[A113]

Among conclusion from studies made in a "research residence," using a cooling coil and forced-air duct distribution, are: Using water at 58°, indoor dry-bulb temperature can be maintained at 80° when outdoor is up to 100°, and indoor relative humidity at 63%. On moderately warm days, effective temperature of 74° and relative humidity of 70% to 80% can be maintained. 60° is probably the upper practicable limit of warm temperature unless an excessive amount of coil surface is used, in order to maintain indoor dry-bulb temperatures as low as 75° in severe weather.[A114]

To prepare for air conditioning, all cities should keep records of present and new installations, with tonnage of refrigeration and water consumption and waste, to furnish data for future estimates.[A115]

Bibliography of Recent Water Works Literature

c, Indicates construction article; n, note or short article; p, paper before a society (complete or abstract); t, technical article.

A *Journal, American Water Works Assn.*
June

107. The Buffalo Water Works. By A. D. Drake. Pp. 763-773.
108. The Montreal Water Works. By C. J. Des Baillets. Pp. 774-790.
109. Method of Determining Wall Thickness of Steel Pipe for Underground Service. By R. E. Barnard. Pp. 791-807.
110. Air Conditioning as a Problem of Water Distribution and Disposal. By L. D. Gayton. Pp. 808-821.
111. Water Requirements of Air Conditioning Machinery. By E. N. Bowles. Pp. 822-825.
112. What Air Conditioning Means to the Water Utility. By L. L. Lewis. Pp. 826-831.
113. Well Water Capacities Available for Air Conditioning. By W. D. Gerber. Pp. 832-835.

114. Study of the Use of Water in Cooling the Research Residence. By A. P. Kratz, M. K. Fahnestock, S. Konzo and E. L. Broderick. Pp. 836-856.
115. Recorded Use of Water for Air Conditioning. By O. C. Holleran. Pp. 857-859.
116. Frazil Ice Problems in Pumping Stations. By R. Dorion. Pp. 860-865.
117. Raising Water Temperature During Severe Winter. By C. Leipold. Pp. 866-871.
118. Aeration. By M. E. Flentje. Pp. 872-880.
119. Safety First in Water Plant Operation. By C. F. Bingham. Pp. 881-884.

E *Engineering News-Record*

July 1

32. Desert Water Tanks. By G. G. Sykes. Pp. 36-37.
33. Fast Tunneling by Charleston, S. C., Water Dept. By J. E. Gibson. Pp. 59-62.

July 15

34. Straitjacketing Chlorine Tanks When Leaks Develop. P. 100.

F *Water Works Engineering*

June 23

77. Plant Lubrication. By H. A. Murray. Pp. 890-894.
78. Repair Methods of Boston's Water Division. By N. N. Wolpert. Pp. 901-905.
79. Laboratory Control: Tests for B. Coli. By C. R. Cox. Pp. 919-920, 923.

July 7

80. Coagulation Aided by Silicates. By J. R. Baylis. Pp. 971-974.
81. Laboratory Control: Use of the Microscope. By C. R. Cox. Pp. 978-979.
82. Dry Ice Increases Well Flow. By F. C. Pratt. P. 987.
83. Water Dept. Pension System at Madison, Wis. By L. A. Smith. Pp. 991-1004.

G *Water Works and Sewerage*

July

27. *p.* Retirement and Pensioning of Water Works Employees. By D. L. Maffitt. Pp. 261-262.
28. *p.* Successful Method of Reducing Hazards and Drainage Claims in Water Utility Operations. By T. W. Coleman. Pp. 274-276.

J *American City*

July

14. Diesel Reduces Pumping Costs at Medham, Mass. By J. W. Greenleaf and B. F. Snow. Pp. 47-50.
15. *p.* Water for Industrial Purposes. By W. D. Collins. Pp. 52-54.

L *Civil Engineering*

July

13. Water Resources of Texas. By J. W. Pritchett. Pp. 462-466.
14. Investigating Ground Water Resources. By S. F. Turner. Pp. 487-490.
15. Organizing for Watershed Development. By T. C. Forrest, Jr. Pp. 490-

M *Canadian Engineer*

June 22

15. Water Works System at St. Stephen, N. B. By A. A. Laflin. Pp. 5-7.

June 29

16. *p.* Water Supplies in Nova Scotia. By R. D. McKay. Pp. 9-10.

July 6

17. *p.* Water Supplies in Nova Scotia. By R. D. McKay. Pp. 9-10.

July 13

18. Reducing Cost of Operating Centrifugal Pumps. By A. Peterson. Pp. 13-16, 19.

P *Public Works*

June

35. Buffalo's Water Waste Problem and Its Solution. By L. S. Spire. Pp. 9-11.
36. Development of Middletown's Efficient Water System. By E. Gebhart. Pp. 18-20.
37. Plugging Dollar Leaks in Water Works Systems. By R. N. Clark. Pp. 25-
38. Alkalinity and Acidity of Water. By W. A. Hardenbergh. Pp. 61-66.

T *Technique Sanitaire et Municipale*

May

3. Le Nouveau Service d'Eau de la Ville de Saint Quentin. Pp. 107-111.

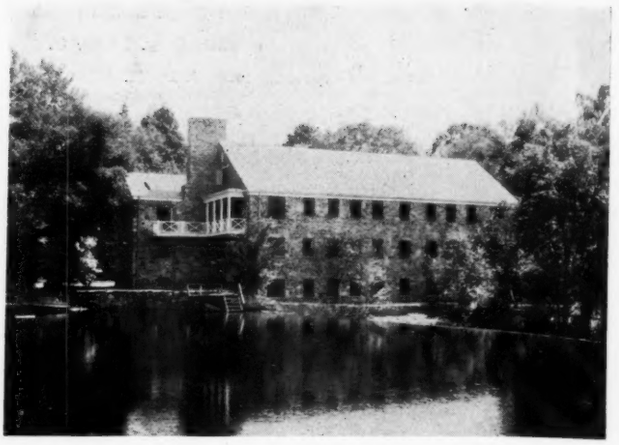
Licensing Water and Sewage Operators In New Jersey

Granting licenses to operate water purification and sewage treatment plants in New Jersey is apparently not a mere matter of form. Two examinations were held during the fiscal year 1935-36. Forty-four applications for sewage licenses were submitted, 39 were accepted for examination, 32 took the examination, and only 18 passed and received licenses. Of these 18, 5 were for grade A, 4 for grade B, 3 for grade D, 2 for grade E, and 4 for grade S.

For water licenses there were 33 applicants, of which 28 were examined and 21 licenses issued; 2 for first class, 2 for second class, 1 for third class and 16 for fourth class.

All together, 35% of those who were examined failed to receive licenses.

New Equipment and Equipment Catalogs



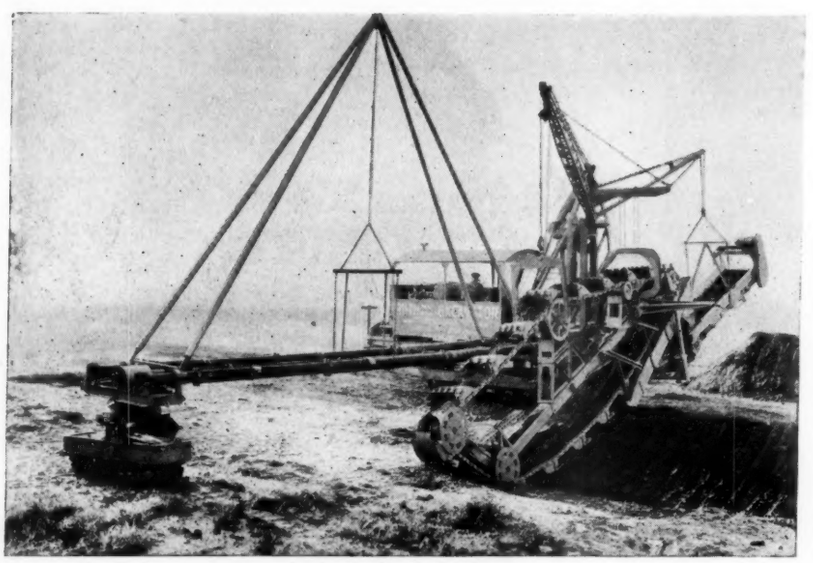
On the foundations of an ancient grist mill near Westport, Conn., stand the research laboratories and test plant of the Dorr Co., manufacturers of sewage and water treatment equipment. Here has centered much valuable research work.

New Ruth Excavator for Drainage and Highways

The new Ruth multi-bucket excavator is designed for digging and excavating drainage and irrigation canals and ditches as well as for their maintenance; levee building and highway construction, is very fast, covers a wide range of ditch shapes, and sizes and working conditions, and is flexible and easy to operate. This Model H-V Ruth multi-bucket excavator has eight forward speeds, two in reverse and four elevator digging speeds. Forward traction speeds while working range from 1 foot to 86 feet per minute; reverse speeds from 2 feet to 59 feet per minute. The elevator digging speeds range from 20 to 47 buckets per minute, with a digging capacity of 180 cubic yards per hour.

The forward speeds of the caterpillar crawlers are synchronized with the digging speeds of the excavating unit, resulting in a constantly maintained digging depth and slope to the desired grade line whether the ditch is dry or full of water—always a uniform cut and a full bucket, plus a finished bank that is straight, even and regular. The buckets have a positive dump feature which ejects the entire contents of each load resulting in a very high digging efficiency whether the material being excavated be wet or dry, or if digging with water in the ditch. The cutting teeth and cutting lips are of high abrasive resistant steel and are replaceable.

Special track pads to meet any working condition are available. When digging from one bank with both crawlers in close-together position, the roadway required is 7 feet. Other models meet any size, type or condition of excavation. The adjustable power driven conveyor deposits the excavated material where desired, as for loading into trucks or other carrying vehicles. Additional information from the manufacturers, the Ruth Dredger Manufacturing Corporation, 5980 South Boyle Avenue, Los Angeles, California.



The new Ruth Multi-bucket Excavator

CATALOGS

Earth Moving:

"From Start to Finish" is a pictorial representation of the use of LeTourneau equipment to handle earth moving jobs all the way from the clearing to the finish of the fine grade. R. G. LeTourneau, Inc., Peoria, Ill.

Rotary Pumps:

Two bulletins, one describing the 3-lobe cycloidal pump for handling tar, asphalt and other heavy materials, and giving capacities; the other covering the application of units for exhausters for priming large centrifugals, etc. Roots-Connersville Blower Corp., Connersville, Ind.

2 and 4-Wheel Scrapers:

Two 2-page folders tell you concisely all about Bucyrus-Erie 2 and 4-wheel scrapers. The former is built in 3½ and 6-yd. capacities; the latter in 4½ and 7-yd. Bucyrus-Erie Co., South Milwaukee, Wisc.

Tractor Scraper:

An 8-page booklet describes the Austin-Western 5-yard tractor scraper. Austin-Western Road Machinery Co., Aurora, Ill.

Fairbanks, Morse Motors:

Bulletin 1600 describes the F-M polyphase wound-rotor or slip-ring, ball bearing, induction motors. These can be operated either at constant or regulated varying speeds. 4 pages. Fairbanks, Morse & Co., Chicago, Ill.

Centrifugal Pumps:

Barnes Mfg. Co., Mansfield, O., have issued a new 8-page bulletin, No. 25B, illustrating and describing self-priming centrifugal pumps.

Corrugated Transite:

Johns-Manville, 22 East 40th St., N. Y., have issued a 12-page bulletin covering the use of corrugated transite for industrial roofing and siding. A full page of drawings, showing construction details, is included.

Caterpillar Auto Patrols:

Caterpillar patrol graders, the work they will do, and their mechanical features are described. Action pictures and detail views are shown. Ask for Form 4052, 40 pages. Caterpillar Tractor Co., Peoria, Ill.

Aurora Pumps:

Three folders are available from Aurora Pump Co., Aurora, Ill., covering deep well turbine pumps (ask for Form 102), single stage centrifugals (ask for Form 105), and double stage centrifugals (ask for Form 106). All three of these are well illustrated and bring out clearly the essential features of Aurora pumps.

New Equipment and Material

The Flow-om-eter

The Flow-om-eter

The Flow-om-eter is an accurate low cost measuring device designed for 4", 6" and 8" flow lines. It is offered primarily to supply the need for an economical instrument to register water used, either legally or otherwise, through fire lines.

For installation, only a 2" tap is made on the top of the pipe. The Flow-om-eter is set and a gate box placed over it.

The Flow-om-eter is manufactured and sold by Northrop & Cook Company, 50 Church Street, New York, N. Y., a company new to the water works field. The two principals, Guy C. Northrop and A. T. Cook, have had long and varied water works experience. Mr. Northrop is General Sales Manager of Hydraulic Development Corporation, makers of HydroTite, and Mr. Cook is General Superintendent and Chief Engineer of the Passaic Valley Water Commission, Paterson, New Jersey.

Road Builder for Heavy Mat and Stabilized Base

The Jaeger Machine Company, Columbus, Ohio, has developed a self-propelled Model MP-2 Road Builder for building heavy retreads and stabilized bases up to 9 inches depth uncompacted by means of one pass mixing-in-place.

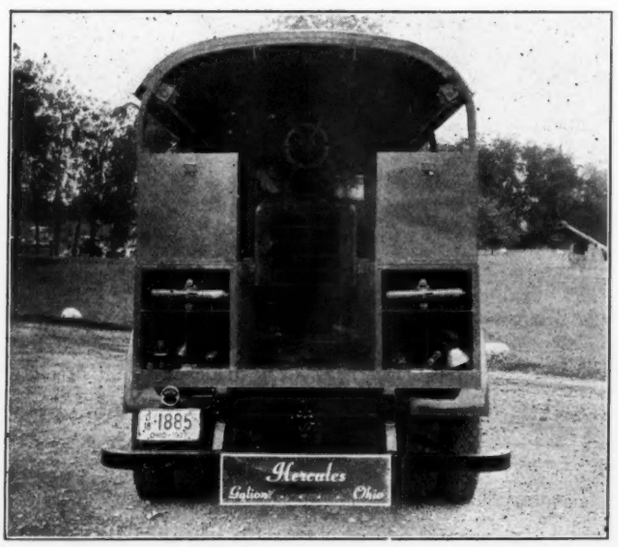
The machine is a combination of two units—a twin pugmill mixing unit, complete with gathering plows and screws, and storage tanks and pumps for applying binder while mixing; and a spreader-finisher unit, consisting of adjustable strike-off mounted on floating straightedge runners 21 ft. long which equalize subgrade irregularities and lay out a smoothly finished surface ready for rolling. Heavy duty crawlers, driven by 130 H.P. engine and steered by individual clutches, propel the Road Builder at speeds consistent with the volume of material being mixed. For example, with single windrows of 8 to 9 cu. ft. per longitudinal foot of road, approximately 70 cu. ft. per minute can be gathered, mixed and spread at a forward speed of 7 to 8 ft. per minute. Smaller windrows are handled at proportionately higher speeds, always in one pass.

Either windrowed material or earth taken direct from the grade after preliminary scarification may be used. The gathering plows have a spread up to 11 ft. and are adjustable so that when gathering material direct from scarified grade, operator can cut to exact grade by holding plows to staked grade line. When gathering windrows from established subgrade, the plows are allowed to float free on sliding shoes following the subgrade. Helical gathering screws gather material into pugmill at a constant rate of feed.

By means of two pumps driven by auxiliary engine, binder material is loaded, while traveling, from tank trucks into storage tanks on the Road Builder and then pumped direct into the pugmill in accurately measured amounts. The use of storage tanks with a combined capacity of 550 gallons provides a reserve of binder material while waiting for the next tank truck to come alongside.

At the rear of the twin pugmill a two-way spreading screw controls distribution of material to the strike-off, which is maintained at average level by the long floating runners on which it is carried. Lanes of 9-10 ft. are spread and finished, with provision on the machine for blending joints between lanes. Where immediate laying of the mixed material is not desired, this finishing unit is removed from the mixing unit and the material left in windrows for aeration or other handling.

According to the Jaeger Machine Company, advantages of the Mix-in-Place Road Builder are: a more accurate and uniform application of binder made at the time of mixing, a more thoro mix of the material in one pass than is possible with unlimited passes of the blade, the opportunity to use quick-curing binders which permit earlier rolling and opening of the road, half width work which keeps one lane always open to traffic, and a smoother riding, longer lasting surface better suited to present-day motoring speeds. In addition, it is pointed out that the contractor saves up to 50% of the cost of equipment ordinarily required for mix-in-place work, plus substantial job savings due to the onepass operation with only two men required on the machine.



Truck-motor-operated utility air compressor unit of Ohio Bell Telephone Co., built by Hercules Steel Products Co., Galion, O. Dodge truck, C-P compressor, air tools, sump pump, barricades, lanterns, etc.

Below, right, the new Jaeger Road Builder which is designed for heavy mat and stabilized base construction.

Binks Trailer Type Striping Outfit

Road Striping Machine

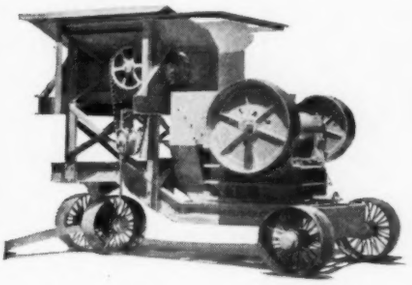
This road striping outfit can be mounted as a trailer and operated from the rear end of a truck, as shown herewith, or mounted on either right or left running board. Striping can be placed at the rate of 6 to 8 miles an hour, and the danger to the men, always present in hand striping, is eliminated. Width of strip is adjustable from 4 to 6 inches. Application is by spray.

When the striping crew desires to move from one location to another, the outfit (either trailer or running board type) can be lifted off the wheels, permitting the truck to move at usual travel speed from job to job. Fuller information from Binks Mfg. Co., 3114 Carroll Ave., Chicago, Ill.

Portable Apron Feeder Crusher Unit

A unique feeder crusher unit recently developed by the Universal Crusher Company, Cedar Rapids, Iowa, for a large high-production rock crushing operation involves the use of a Universal primary jaw crusher mounted on a portable rig, together with an apron feeder super-imposed above it permitting of a steady feed of rock into the crusher.

The maker states, "This apron feeder not only speeds up output by maintaining a steady flow of rock to the crusher, but saves much time formerly required in setting up and dismantling stationary feeders which are usually bulky permanent units."



Universal Crusher and Feeder Unit

This combination of crusher and feeder mounted on a single mobile unit is made to operate in conjunction with a similar crushing equipment on which is mounted a roll crusher for secondary crushing. A belt conveyor carries the primary crushed rock from one crusher to the other; a second conveyor unit handling the final product to temporary storage bins.

Preformed Rubber Expansion Joint Filler

A new type of rubber expansion joint filler for all conventional joint openings used in concrete highways, structures, curbs, sidewalks, tanks and other miscellaneous types of construction has recently been introduced by the B. F. Goodrich Company, Akron, Ohio.

These preformed strips are made of rubber specially compounded for great age and wear-resisting qualities. They are designed with flexible lips on the two sides, which project upward against the concrete surface of the joint opening, making their removal very difficult. In order that the strips may be easily compressed, they are made with a large tubular opening in the center. The top surface is slightly indented or grooved to provide for downward thrust of surface upon compression. Due to this latter feature, it is impossible for material to extrude above wearing surface of the pavement.

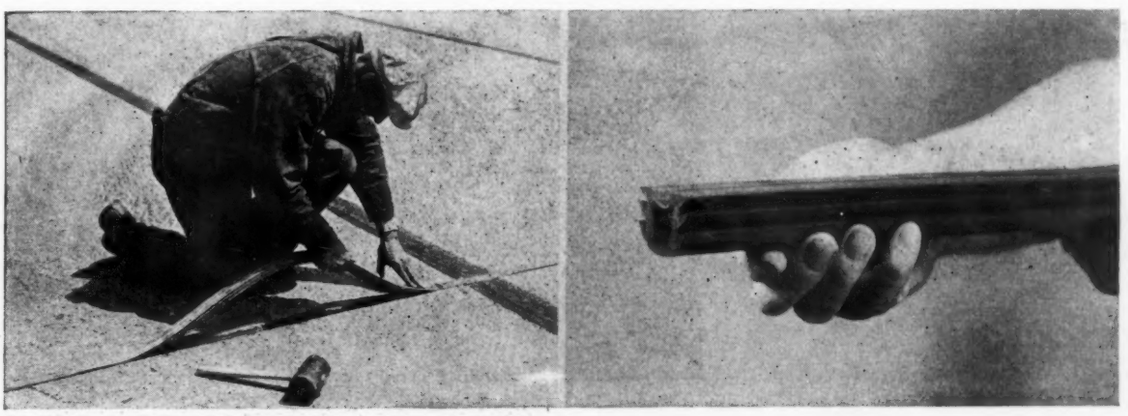
The strips are designed to be placed under partial compression as they are made about 25% wider than the opening in which they are to be used. This permits the rubber to follow the concrete as it contracts and yet compress readily when the concrete expands. The recommended method of use is to place the strips in the bottom, ends and top of the joint opening which provides a rubber gasket around the entire cross-section of the pavement or structure. These strips can also be used with the several types of joint opening devices and make efficient seals for air cushion joints.

Advantages claimed for this new Goodrich preformed rubber expansion joint filler are that it eliminates expensive joint maintenance work; is low in cost; entails no waste through trimming; cannot be damaged by ordinary handling; is quickly installed by unskilled workmen without aid of special tools.

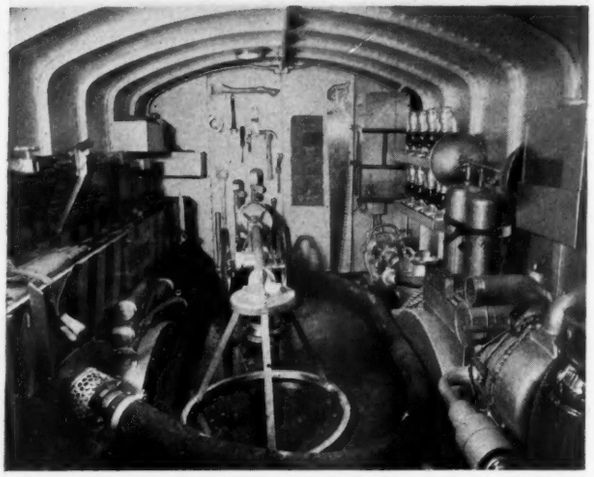
To date installations of these preformed rubber strips have been made in highways in Ohio, Indiana, Michigan, the District of Columbia, Tennessee and Georgia.

Mine Safety Appliances Co., Pittsburgh, Pa., have issued a description of their new sanitary portable drinking fountain. Fine for field and construction work. Data on request.

Schramm, Inc., air compressor manufacturers of West Chester, Pa., will occupy a new 25,000-sq. ft. factory addition within a month.

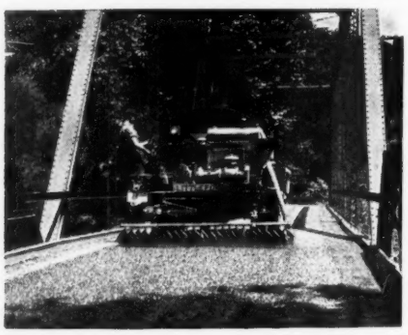


Installing the Goodrich joint (left) and a close-up view of the joint material



The new emergency truck of the Duluth, Minn., water and light department has all sorts of gadgets and equipment. Here is the interior, with flood lights, hose, pumps, lanterns and small tools. Felix Seligman is manager of the Water and Light Dept. Photo furnished by Homelite Corp.

International Harvester I-12 industrial tractor handles refuse in a large Los Angeles, Calif., incinerating plant by means of 6-ft. bulldozer blade.

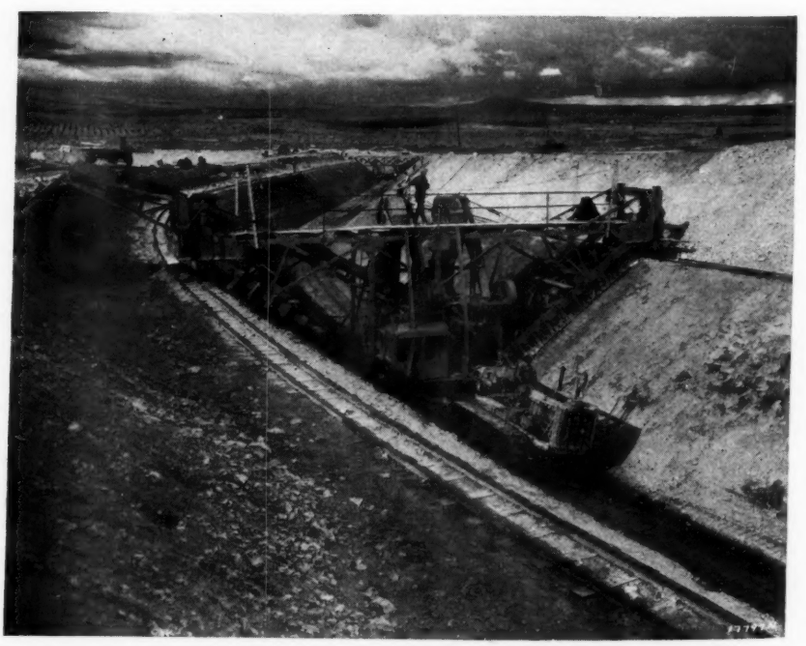


Littleford distributor retreading wood block bridge floor in Ohio.

Luck-E-Lite highway torch made by Embury Mfg. Co., Warsaw, N. Y. Weatherproof, easily carried, 24 to 48 hours with one refilling. Folder on request.

New carbide lantern with safety flame protector, insulated handle, heat resisting glass lens, and corrosion resistant water and carbide chambers. Details from National Carbide Corp., 60 East 42nd St., New York.

New blast hole drill for heavy work introduced by Bucyrus-Erie Co. Weighs 18,400 lbs. and has a tool capacity of 2,000 lbs. 33 or 40-ft. derrick, gasoline, diesel or electric power.



Caterpillar "75" diesel pulls this ditch shaper on Roasa irrigation canal, near Yakima, Wash.

Readers' Service Department

These booklets are FREE to readers of PUBLIC WORKS.

CONTINUED FROM PAGE 56

Cast Iron Sewers

385. For use in wet ground to prevent infiltration, for crossing under railways and heavy duty highways, and for all other sewer construction where replacement, repairs or reconstruction would be costly, cast iron pipe is most economical. For details, specifications, etc., write Thomas F. Wolfe, Cast Iron Pipe Research Ass'n, 1013 Peoples Gas Bldg., Chicago, Ill.

Couplings for Pipe

386. This sixteen-page booklet is a reprint of a magazine article by a consulting engineer. It describes in detail the installation of a 42" water line; contains specific information regarding pipe joints, field organization, laying pipe, tests, back-filling, etc. Sent free by S. R. Dresser Manufacturing Company, Bradford, Pa.

Feeders, Chlorine and Chemical

387. For chlorinating small water supplies, swimming pools and other installations. Flow of water controls dosage of chlorine (or other chemicals) providing required dosages, which are immediately adjustable. Driving is started and stopped automatically. Send for newest literature. %Proportioneers%, 9 Codding St., Providence, R. I.

Fire Hydrants

388. Two new bulletins on M-H fire hydrants and fully bronze mounted gate valves are now ready. Contain full specifications and instructions for ordering, installing, repairing, lengthening and using. Write M. & H. Valve & Fitting Co., Anniston, Ala.

Gate Valves

390. 28 page catalog contains illustrations and complete specifications of M-H standard and extra heavy iron body gate valves, horizontal swing check valves, flanged fittings and flanges, etc. Sent promptly on request by M. & H. Valve & Fittings Co., Anniston, Ala.

Manhole Covers and Inlets

403. Nuisance from loose, noisy manhole covers is eliminated by the use of Westeel rubber cushioned manhole covers and gratings. Six special advantages are explained in a new illustrated bulletin just issued by the West Steel Casting Co., 805 East 70th St., Cleveland, Ohio.

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter, crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

Pipe, Cast Iron

406. Data on cast iron pipe for water works systems, in sizes from 1¼ to 84 inches, including information on useful life, flow data, dimensions, etc., Thos. F. Wolfe, Cast Iron Pipe Research Ass'n, 1013 Peoples Gas Bldg., Chicago, Ill.

Pipe, 2-inch Cast Iron

407. The new McWane 2" cast iron pipe in 18-foot lengths has innumerable uses in water and sewage work. Send for the new McWane bulletin describing this pipe, the various joints used, and other details about it. McWane Cast Iron Pipe Co., Birmingham, Ala.

Pipe, Large Cast Iron

408. Handy cast iron pipe and fittings catalog contains A.W.W.A. and A.G.I. standard specifications for a wide variety of cast iron pipe specialties, both bell and spigot and flanged; also dimensions Lynchburg Foundry Co., Lynchburg, Va.

Pipe, Steel

409. A very complete, 60 page, illustrated bulletin on spiral welded pipe including lots of useful engineering information, hydraulic data, flow charts, specifications, etc., issued by American Rolling Mill Co., Pipe Sales Div., 1101 Curtis St., Middletown, Ohio.

Pipe Forms

411. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pipe Joints

413. New folder describes in detail a new type of pipe joint—the Dresser Compression Coupling, Style 65, which is compact and self contained, makes a permanently tight joint under all conditions and is installed on plain end pipe in a few seconds with only one tool, a wrench. Get your copy today. S. R. Dresser Mfg. Co., Bradford, Pa.

Pipe Joint Compound

414. A new bulletin has recently been issued giving full details concerning Tegul Mineralead, a quick-sealing, trouble-free compound for bell and spigot joints which permits immediate closing of the trenches. Write The Atlas Mineral Products Co. of Pa., Mertztown, Pa.

Taste and Odor Control

417. How, when, and where activated carbon can and should be used to remove all kinds of tastes and odors from water supplies is told in a new booklet just issued by Industrial Chemical Sales Div., 230 Park Ave., New York, N. Y. 32 pages, table, illustrations and usable data.

418. Information on activated carbon for taste and odor control including data on operating experiences. Write L. A. Salamon & Bro., 216 Pearl St., New York, N. Y.

Pumps and Well Water Systems

420. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps, fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for these three descriptive booklets. Layne & Bowler, Inc., Dept. W, General Office Memphis, Tenn.

Protective Pipe Coating

422. Coal-tar Pitch Enamels for exterior and interior linings for steel water lines; highly resistant to water absorption, soil acids and alkalis. Technical specifications for materials and their application will be sent on request. The Barrett Company, 40 Rector St., New York, N. Y.

Pumping Engines

424. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Run-off and Stream-Flow

425. Excellent booklet describes and illustrates the latest types of instruments for measuring run-off, both from small areas for storm sewer design, and from large areas for determining water shed yield. Sent promptly by Julien P. Friez & Sons, Baltimore, Md.

Screens, Sewage

427. The simple, automatic Laughlin self-cleaning, traveling screen is fully described in an interesting bulletin issued by Filtration Equipment Co., 10 East 40th St., New York, N. Y.

428. Be assured of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straight-line Bar Screens" (Vertical and Inclined types). Link-Belt Co., 307 N. Michigan Avenue, Chicago, Ill.

Setting and Testing Equipment for Water Meters

430. All about setting and testing equipment for Water Meters—a beautifully printed and illustrated 40 page booklet giving full details concerning Ford setting and testing apparatus for all climates. Ford Meter Box Co., Wabash, Ind.

Rainfall Measurement

432. The measurement of precipitation, exposure of gauges, description of apparatus for measuring rainfall, both rates and amounts. Bulletin RG and Instruction Booklet. Julien P. Friez & Sons, Baltimore, Md.

Screens

435. Water Screen Book No. 1252, describes traveling water intake screens and gives complete technical information about them. Link-Belt Co., 307 No. Michigan Ave., Chicago, Ill.

Sludge Incineration

438. A multiple hearth furnace which meets the most exacting municipal sanitary requirements for the incineration of sewage sludge—produces a fine ash or partially dry sludge for fertilizer—is described and illustrated with drawings and photographs in bulletins issued by Nichols Engineering and Research Corp., 40 Wall St., New York, N. Y. Operation as well as installation data is given.

440. Disposal of Municipal Refuse: Planning a disposal system; specifications. The production of refuse, weights, volume, characteristics. Fuel requirements for incineration. Suggestions for plant inspection, 45 pp., Ill. Also detailed outline of factors involved in preparation of plans and specifications. Morse-Boulger Destructor Co., 202P East 44th St., N. Y.

Swimming Pool Equipment

444. Filters, chlorination, underwater lights and other supplies for swimming pools are very thoroughly described in literature and folders. Plans and layouts. Everson Filter Co., 214 West Huron St., Chicago, Ill.

445. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

Treatment

448. New 31-page catalog covers complete conveying, screening and reduction machinery for water purification and sewage treatment; describes and illustrates the design features of Jeffrey self-cleaning bar screen, combined screen and grinder, sewage screenings grinder, grit washer, conveyor type and positive discharge sludge collectors and green garbage grinder—includes installation views. Catalog 615, Jeffrey Manufacturing Co., Columbus, Ohio.

450. Standard Sewage Siphons for small disposal plants and PFT Rotary Distributors are new catalogs recently issued by Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill. The latter catalog contains typical plans and many illustrations of actual installations.

452. Eliminate sludge bed troubles, forget about weather conditions, odor nuisance, hail insurance and the like. Full details as to how Oliver United Vacuum Filters overcome these problems will be sent to all interested by Oliver United Filters, Inc., 33 West 42nd St., New York, N. Y.

453. How to avoid sludge and scum troubles in settling tanks explained in detail in Book No. 1542—has excellent drawings and photographs, also specifications. Most important are the carefully prepared capacity tables. Link-Belt Co., 307 N. Michigan Ave., Chicago, Illinois.

454. Full information regarding their newest equipment for sewage treatment and water purification will be sent on request by The Dorr Co., 570 Lexington Ave., New York, N. Y.

Thawing Equipment

460. Complete details concerning this quick-acting, efficient, electric pipe thawer which sells for only $39.25 complete, will be sent promptly by Commonwealth Mfg. Corp., Dept. P-710, 3785 Beachmont Ave., Cincinnati, Ohio.

Water Works Operating Practices

490. This is a reprint of two excellent papers by F. E. Stuart. One outlines a number of filtration and field practices of value. The other presents a lot of kinks the author has picked up in visits to more than 1,000 water works plants. Sent free by Activated Alum Corp., Curtis Bay, Baltimore, Md.

For the Engineer's Library

Brief reviews of the latest books, booklets and catalogs for the public works engineer.

Designed Economy for Water Supply:

Loose leaf; 48 pages. Devoted to Armco spiral welded pipe for water and sewerage. Mostly technical data. Tables give complete information on outside and inside diameters, gages, thicknesses, inside cross-sectional areas, working and collapsing pressures. Also full information on Dresser, Victaulic, flanged, riveted, welded, screw and special joints; and on soil corrosion in various parts of the country and on protective coatings. Field installation data; hydraulics are treated fully with some very fine flow charts using Scobey and Hazen-Williams formulas, and with examples of flow determination. Sent on request to American Rolling Mill Co., Middletown, Ohio. Ask for Bulletin 136.

Corrugated Piling:

Excellent 18-page catalog of corrugated steel sheet piling, gives complete technical information on gages, weights, sections, etc., shows methods of installation and use (including corner interlocks) for sewage, water plant and other excavation; and presents excellent sketches of methods of use for flood protection walls, dam diaphragms, soil erosion and flood control structures and sea and dock walls. This will be sent on request to Corrugated Steel Sheet Piling Corp., Builders Building, Chicago, Ill.

Pipe Protection:

Contents of this "book of pipe protection" include: Principles of pipe protection, priming, coating and wrapping, loading, materials, multi-coat linings, lining materials and cold coating for interior pipe surfaces. There is much of value in this text for the engineer who contemplates using steel pipe for sewage or for many kinds of water. Technical section is 20 pages; prices and weights 18 pages. Sent on request to General Paint Corp., Hill, Hubbell & Co. Division, Mayfield Road, Cleveland, Ohio.

Sump Pumps:

Reducing the often not well understood details of pump construction and pump selection to comparatively simple charts and diagrams, this 20-page bulletin ought to be a help to engineers in getting to the bottom of the sump-pump proposition. Sent on request to Yeomans Bros. Co., 1433 Dayton St., Chicago, Ill.

Welded Piping Design:

Complete handbook information on design and layout of piping for welded connections is contained in a 200-page (6x9) booklet containing over 100 figures and tables, published by The Linde Air Products Company, New York. Subjects treated of interest to engineers are fundamentals of welded joint design; welding metallurgy; standard welded pipe connections; design data on welding cast iron, galvanized iron, stainless steel and non-ferrous piping; advantageous layout; fabrication and erection considerations; welded anchors and supports; and welding speeds. Sent on request, we believe, as no price is given.

Deep Well Turbine Pumps:

The new Deep Well Turbine Pump Section of the Hydraulic Institute Standards has just been published. It includes definitions of deep well turbine pump parts and materials; conditions of sale; definitions of efficiencies and methods of testing; what to look for in the event of pumping troubles; charts and explanations of column friction losses and mechanical friction in turbine pump line shafts; description of power balance in a deep well turbine pump; air line method of determining depth of water level and method of plumbing a well. Price of this section is 25 cents or it will be furnished with the complete book of Standards which is priced at $1.00. Copies from C. H. Rohrbach, 90 West Street, New York, N. Y.

Arc Welding:

A manual of arc welding and an operators' training course has been published in booklet form by Hobart Bros., Troy, O. This sells for 50 cents. It contains 94 pages, nearly all of value to the welder. Chapters: The welding arc; welding equipment; weldability of metals; types of joints and welds; strength of welds; speed and cost of welding; using the metallic arc; welding with bare electrodes, and welding with coated electrodes.

Snow Plows:

Various types and models of snow plows are described and discussed in Frink catalogs, including the "one-way speed Sno-Plows" and the "V" type plows. A lot of illustrations and plenty of "how to do it." Carl H. Frink, Mfr., Clayton, New York.

Sewage Sludge Gas Engines:

An 8-page booklet describes use of sewage sludge gas for engines, shows installations and gives some data of value for approximating the power available. Worthington, Harrison, N. J.

Gravel Washing Plants:

A right good catalog and booklet that describes and illustrates portable washing attachments and equipment, and also shows a number of plant layouts. Sent on request to Iowa Mfg. Co., Cedar Rapids, Iowa.

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